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A Peer Reviewed Journal for SOF Medical Professionals

See the TCCC Updates section for the new SOF Tactical Trauma Protocol (SOF TTP)

UNCONVENTIONAL WARFARE

UNCONVENTIONAL MEDICINE

TACTICAL COMBAT PREHOSPITAL TRAUMA CARE

ERIC FONTE

- **U.S. Special Forces Medics in Afghanistan Look to Partner with NGOs on Rural Health**
- **Time for a Change: Recommended MTOE Rank Adjustment for Army Special Operations Physician Assistants**
- **Suspected Dietary Supplement Injuries in Special Operations Soldiers**
- **The Use of Fresh Whole Blood Transfusions by the SOF Medic for Hemostatic Resuscitation in the Austere Environment**
- **Management of Urinary Retention in an Austere Environment: Suprapubic Catheter Placement**
- **Zoonotic and Infectious Disease Surveillance in Central America: Honduran Feral Cats Positive for Toxoplasma, Trypanosoma, Leishmania, Rickettsia, and Lyme disease**
- **Dental Team Aids, Trains West African Countries**

Dedicated to the Indomitable Spirit & Sacrifices of the SOF Medic

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FROM THE EDITOR

The *Journal of Special Operations Medicine's (JSOM)* mission is to promote the professional development of Special Operations medical personnel by providing a forum for the examination of the latest advancements in medicine and the history of unconventional warfare medicine.

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Lt Col Michelle DuGuay Landers

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Dedication



SGM Bradly D. Conner

Sergeant Major Bradly D. Conner was born 5 March 1966, in Tacoma, WA. He was a Special Forces company sergeant major assigned to Company C, 2nd Battalion, 1st Special Forces Group (Airborne).

Conner died 9 May 2007 from wounds sustained while conducting a combat patrol outside of Al-Hillah, Iraq.

He deployed in support of Operation Iraqi Freedom in March 2007. It was his fourth deployment to Iraq since 2003.

A native of Tacoma, WA and raised in Coeur d'Alene, ID, Conner enlisted in the Army 24 June 1987, as an ammunition specialist. After completing basic training at Fort McClellan, AL, and advanced individual training at Redstone Arsenal, he was assigned to the 515th Ordnance Company, Redstone Arsenal as his first assignment. In 1992, Conner volunteered for Special Forces training and upon completion of the Special Forces Qualification Course in 1993, he was assigned to 10th SFG (A) as a Special Forces medical sergeant. He filled several positions in 10th SFG (A) to include 2nd Battalion S3 Operations NCO, team sergeant, and first sergeant for HHC.

Conner's awards and decorations include the Bronze Star Medal Second Oak Leaf Cluster, Purple Heart, Meritorious Service Medal - Second Oak Leaf Cluster, Joint Service Commendation Medal - Second Oak Leaf Cluster, Army Commendation Medal - Fifth Oak Leaf Cluster, Army Achievement Medal - Sixth Oak Leaf Cluster, Joint Meritorious Unit Award, Good Conduct Medal - Fifth Award, National Defense Service Medal - Second Award, Armed Forces Expeditionary Medal, Southwest Asia Service Medal, Kosovo Campaign Medal, Global War on Terrorism Expeditionary Medal, Global War on Terrorism Service Medal, Armed Forces Service Medal, Military Outstanding Volunteer Service Medal, Noncommissioned Officer Professional Development Ribbon, Overseas Service Ribbon, Army Service Ribbon, Kuwait Liberation Medal, NATO Medal, Combat Infantryman Badge, Master Parachutist Badge, Military Freefall Parachutist Badge and the Special Forces Tab.

Conner is survived by his wife, a son, and two daughters. He is also survived by his parents, two brothers, and a sister.

- DE OPPRESSO LIBER -



SSG Marc J. Small



Staff Sergeant Marc J. Small, 29, died of wounds sustained from enemy fire during a combat reconnaissance patrol on 13 February 2009. He was a Special Forces Operational Detachment-Alpha team medical sergeant assigned to Company B, 1st Battalion, 3rd Special Forces Group (Airborne).

He deployed in support of Operation Enduring Freedom in January 2009 as a member of the Combined Joint Special Operations Task Force – Afghanistan. This was his first deployment in support of the Global War on Terror.

Marc was a graduate of Methacton High School, class of 1997. He attended the Citadel as well as Millersville University. Small, a native of Collegeville, PA, volunteered for military service and entered the Army in December 2004 as a Special Forces trainee. After basic and advanced individual training at Fort Benning, GA, he was assigned to the John F. Kennedy Special Warfare Center and School at Fort Bragg, NC, in May 2005 for Special Forces training. His medical training was with John F. Kennedy Special Warfare Center and School at Joint Special Operation Medical Training Center. He earned the coveted “Green Beret” in 2007 and was assigned to 1st Bn, 3rd SFG(A) at Fort Bragg, NC, as a Special Forces medical sergeant.

Small’s military education includes the Survival, Evasion, Resistance, and Escape Course, Sniper Course, Basic Airborne Course, Basic Noncommissioned Officer Course, Warrior Leaders Course, and Special Forces Qualification Course.

His awards and decorations include the Army Commendation Medal, Army Achievement Medal, Good Conduct Medal, National Defense Service Medal, Afghanistan Campaign Medal, Global War on Terrorism Service Medal, Noncommissioned Officer Professional Development Ribbon, Army Service Ribbon, Overseas Service Medal, NATO Medal, Parachutist Badge, Combat Infantry Badge, and the Special Forces Tab. He was posthumously awarded the Bronze Star Medal, Purple Heart, and Meritorious Service Medal.

Small is survived by his mother and stepfather, father and stepmother, five siblings, and his fiancé.

- *DE OPPRESSO LIBER* -

MEDIC RECOGNITION



CPT Andrew D. Fisher

RANGER NAMED TOP PA

Captain Andrew D. Fisher of 1st Battalion, 75th Ranger Regiment has been selected for the Surgeon General's Physician Assistant Recognition Award.

While deployed to Afghanistan in 2009, Fisher trained the regiment's medics and provided exceptional daily care, as well as treating combat casualties during several intense firefights.

On 30 September, Fisher treated six injured Rangers, four of them classified urgent, during a combat mission. When the platoon medic's weapon malfunctioned, Fisher joined the assault force and helped overrun the target despite intense machinegun fire. He also recovered casualties and coordinated evacuation and care en route.

On 25 October, Fisher responded when two Marine attack helicopters supporting an operation crashed. Despite rounds cooking off, burning wreckage, and hot debris, he established a casualty collection point and treated the two Marines who survived until they were evacuated. He then helped secure the site and recover remains of those killed in the crash.



SFC JOHN DOBBINS 160TH SOAR (A) MEDICAL OPERATIONS NCOIC

CPT Kyle Faudree, APA-C, FP-C 160th SOAR (A) Regiment PA

SFC John Dobbins is a senior medic in the 160th SOAR(A), trusted leader, loyal Soldier, and friend. I have known John since he was an E-3 and first arrived to the unit from 91B AIT in 2001 while awaiting a SOCM date. He was a pretty quiet guy (which he still is) and always looked for more challenges in his career. He knew the opportunities that were presented to him as a young Nightstalker. He is now the Med Ops NCOIC responsible for the final emplacement of all medical officers and medics in two theaters of operations, as well as CONUS and OCONUS training events. There is no other more capable and professional NCO among our ranks. He has served the 160th as an Aid Station Medic, Battalion Junior Medic, Regiment Flight Medic Standardization Instructor, 2/160th Battalion Senior Medic, 1/160th Battalion Senior Medic, and now as the Medical Operations NCOIC. He has consistently sought increased responsibility and training to increase his fund of knowledge in order to better provide for the wounded SOF Soldiers on the battlefield. He has deployed multiple times since 2003 to both Operations ENDURING FREEDOM AND IRAQI FREEDOM and all times conducts himself as a SOF medical professional.

His daily duties include monitoring multiple rotary wing task forces deployed in two countries for any updated requirements as needed from the deployed SOF medics. He ensures that the right people and equipment are in place as required to conduct the time sensitive nature of precision Special Operations Aviation. He is responsive to the needs of the Medical Officers and medics, regardless of rank or stature in the organization. He schedules all required pipeline schooling for the 160th medics and medical officers, as well as receiving, prioritizing, deconflicting, and assigning countless medical taskings each day.

He constantly mentors subordinate medics, thus improving the medical care provided to unit members. His focus is not only on issues at the Regiment level but in the day to day operations of a 15,000 visit per year clinic that is operated on the 160th SOAR (A) compound. He is a “fixer” and is constantly sought out to bring resolution in difficult decisions. His mental and physical toughness is combat proven. SFC John Dobbins is the “Special Operations Quiet Professional” and represents the medical members of his organization superbly. He is an exemplary leader, Soldier, and father; and I am proud that he is a member of the 160th Medical Team. He is the finest example of a warrior medic, and I would trust my life in his hands should the occasion arise. Night Stalkers Don’t Quit!



U.S. Special Forces Medics in Afghanistan Look to Partner with NGOs on Rural Health

Matt Pueschel

Force Health Protection and Readiness Staff Writer

U.S. Special Forces (SF) medics operating in small groups in remote areas of Afghanistan can make significant health impacts by assimilating themselves into the local culture, and working side-by-side with Afghan medical providers.

They often grow beards and don the local attire to fit in, in contrast to larger conventional forces that mostly operate in the country's urban centers. In a recent discussion convened by the International Health Division within the Department of Defense (DoD) Force Health Protection and Readiness (FHP&R) offices, some SOF medics who had just redeployed from Afghanistan, and several DoD, U.S. government inter-agency, and international health policy leaders, broached the idea of having a development or non-governmental organization (NGO) specialist accompany the medics on some of their medical outreach missions. Since the SF medics often blend in with the culture, the missions could hold appeal for civilian aid agencies, contractors, or NGOs to partner and help make more sustainable inroads on rural health in Afghanistan.

"SF guys are going in, but no one takes over after each one leaves," said CPT Dan Winschel, PA-C and former SF medic (18D), who has done two tours in Iraq ('03, '05) and one in Afghanistan last year. "We need to tie in with international organizations (IOs) and NGOs to survey the ground situation and security in remote areas and have a bigger impact."

Dr. Warner Anderson, Director of FHP&R's International Health Division (IHD), raised the possibility of DoD contracting NGO expert liaisons to assist military medical personnel in connecting with their civilian counterparts in places like Afghanistan. He said it worked very well following the 12 Jan earthquake in Haiti. IHD member Dr. Lynn Lawry had extensive NGO experience and expertise and was funded by the NGO International Medical Corps to travel to the disaster site. Once there, Dr Lawry assisted with interagency medical relief coordination (please see resulting paper at: (<http://content.nejm.org/cgi/content/full/NEJMp1001555>)). "I also think we need to do a better job working with our Army Civil Affairs guys" added CPT Winschel. "As the military, we need li-

aisons to reach out to NGOs. There needs to be someone to bridge the gap because there is a huge gap of what we could be getting out of it. Maybe a broker from the Department of State to say we're going to be here a long time (would be helpful)."

John Dunlop, a U.S. Agency for International Development (USAID) officer for military affairs, said SF medics and NGOs working together could be very positive and allow for more flexibility and less bureaucracy than the regular Army might. "You can have that flexibility between SF and NGOs to interact with the UN, IOs, and NGOs," he said.

Dr. Anderson referenced an iconic black and white photograph of U.S. Special Forces riding on horseback with Northern Alliance members in Afghanistan in 2002 as a testament to SF Soldiers' efforts to learn about and work from within other cultures. "All SF Soldiers are trained in local languages and given extensive cultural awareness classes," CPT Winschel said. "Wearing of local garb is just what feels right when interacting with the locals. They feel you are more relaxed and it opens to cultural interaction. We would often join the locals in celebrating their holidays, family birthdays, and even weddings when the opportunities allowed. This is a general way of making inroads and developing trust. The growing of beards is another way of being respected in their culture (a beard is also a sign of masculinity there)."

The U.S. Special Operations Command does a good job of training SF Soldiers on all aspects of the particular culture they will be working in, including language training, said CPT Winschel. "The numerous rotations have required other SF groups, which normally would not operate in the Middle East, to rotate over to operations in Iraq or Afghanistan. These Soldiers rely on their interpreters to communicate with the local forces and civilians. For example, I did not get any Dari language training for my rotation in Afghanistan; however, the cultural courses do teach you some salutations and common phrases."

CPT Winschel said the Special Forces are trained to be diplomats. "In Iraq, NGOs had their own security, but we would interchange assessments and develop courses of action that would help coordinate

civil-military operations. This time, in Bagram (Airbase-Afghanistan), NGOs and IOs were either on the base or would travel from one major city to another; however, they never made it to the remote areas like they did in Iraq. The Afghan National Army (ANA) could accompany them and facilitate such assessments, and (they could help) develop more sustainable projects and programs if we could get the security improved.”

IMPROVING MEDICAL SUPPORT TO STABILITY OPERATIONS

One of the primary objectives of IHD is to develop policy for Military Health System (MHS) support to international stability operations. The division wrote a health instruction (DoDI 6000.16) for such missions that was approved in May 2010, and outlines military responsibilities in planning for and conducting medical stability operations. It directs the MHS to be prepared to establish, reconstitute, and maintain the health sector capacity and capability for other populations when local, international, or U.S. civilian professionals cannot do so. IHD is also developing a MHS capabilities needs assessment and medical stability operations training plan for DoD personnel that promotes interoperability with other relevant agencies. “If you think strategically, you see health as a matter of development,” Dr. Anderson said. “In DoD, health assets are those of the line commander; historically, to care for the troops, but also host nations. There is a history of the U.S. military providing direct care services to other countries that is partly humanitarian, but also a matter of stabilization. I maintain it is the medical officer’s responsibility to take a health neutral thing like a MEDCAP (short-term medical civic action project) and turn it into a positive thing, and it is our job to show them how.”

The new health instruction builds off a policy (DoDI 3000.05) that was issued last September and stemmed from a 2005 department directive that establishes stability operations as a core U.S. military mission. DoD must be prepared to carry them out with a proficiency that is on par with combat operations. The policy requires DoD to support, jointly plan, and conduct stability operations led by other U.S. government agencies and to collaborate with allied governments, their security forces, international, and regional government organizations, NGOs, and the private sector. DoD must further be prepared to lead stability operations whenever necessary, heed national and international laws, establish security, restore essential services, repair critical infrastructure, and provide humanitarian assistance. Global MHS interactions involving host country health infrastructure and care to civilians can take place across the range of peacetime, disaster, conflict, and post-trauma environments.

Special Forces is just one military element that can contribute to building local health capacity and stability, and their adaptive, unconventional nature carries

the potential to make significant impacts in counterinsurgency development efforts. “The U.S. Army Special Forces were created to provide direct contact with foreign nationals by living among them and by organizing guerrilla groups in those countries,” Dr. Anderson said. “They are supposed to be interlocutors, interact with cultures, train, and equip them.”

Since these missions are dangerous, SF medics are also trained to provide situational awareness and security. “My job was to be a clinical facilitator,” CPT Winschel said. “You have to be aware of your surroundings. The SF Soldiers are really the only ones going into the most remote areas and it is required that they go with their partnered host country unit (in Afghanistan, they would go with the ANA, Afghan National Police, or SF Commandos).”

Since conventional Army units are not getting out to these remote areas due to their mission requirements, CPT Winschel would recruit physicians, dentists, and veterinarians from those units to support the SF medics’ mission requests to host a Village Medical Outreach Project (VMOP), which provides care to a local village for one to two weeks. “I had to get approval from the conventional Army unit or hospital commander,” he advised. “All the commanders were very supportive and believed in opportunities to help the Afghan war effort. I would brief the recruits on what was needed. Once I got the hand-picked team of (Army medical) specialists flown into the rural SF firebase, I would have them briefed by the SF Operational Detachment Alpha (ODA) team leader and sergeant.”

At the same time, CPT Winschel would get the local ANA or ANP unit medics and doctors involved with the VMOP. “The partnerships with the U.S. specialists enhanced their overall medical capabilities,” he said. “The face of the operations were the local (Afghan) units. The SF Soldiers would advise and train them. The SF team medics ran the operation and I would be the clinical facilitator.”

When providing direct care to local civilians, Dr. Anderson stressed that it is crucial the U.S. medics do not provide treatment that cannot be sustained locally, and at a minimum, causes no harm to patients.

“The SF officer-in-charge tells his battalion surgeon to do a MEDCAP and then it’s up to the surgeon to do no harm,” he advised.

CPT Winschel credits LTC Gilliam, the Commander of the 2nd Battalion, 19th Special Forces Group-Airborne, for his leadership in this area. “He was the one who delegated that I become the VMOP commander and help his ODAs run their VMOPs.”

MAKING AN IMPACT IN REMOTE AREAS

CPT Winschel said simple things can often help local populations in significant ways, such as civic action projects that he developed and managed with NGOs and IOs in Iraq. As a 443rd Civil Affairs Offi-

cer, for instance, he was asked by local doctors if he could get them medical textbooks. The doctors wanted to teach their own students so they could take care of their own people. CPT Winschel put out the word through his Special Forces Chapter 54 in Boston and that organization got the word out to former SF Soldiers who in turn donated books. The books came in by the plane load and before long, they delivered countless medical textbooks to local providers and formed 16 new medical libraries throughout northern Iraq in the process.

Another project involved handing out shoes donated from U.S. citizens to Afghan village children and adults, and bringing in flour, sugar, blankets, and tools. “We try to help these people help themselves,” CPT Winschel said. “We work with village elders and religious leaders to distribute medical care out of a tailgate of a truck (at times).”

At one of the Afghanistan forward operating base clinics he worked in, CPT Winschel removed a bullet from a local man who was shot 30 years ago. This was one of many opportunities he and his SF medics and Marine Special Operations Team Corpsmen had to train Afghan medics on basic surgical capabilities in the field, he said. “We got Afghan medics to run sick call on their men and treat combat wounds,” he said. “We were able to greatly enhance the overall medical capabilities of these Afghan medics.”

It is actions such as these, even in rural areas, that can help garner the support of the population overall. Furthermore, with over 50 SF medical clinics in Afghanistan that serve as the primary medical provider in remote areas and can stabilize patients for 24 hours or more, a widespread impact can be made. Special Operations Medical Association (SOMA) President LTC Bob Harrington, spoke to the group at the FHP&R offices about his recent experiences as a dentist at a rural Special Forces medical clinic in Afghanistan. He said the SF firebase clinics treat thousands of people a year, performing surgeries and lifesaving procedures. They are manned by 15 to 18 U.S. personnel and approximately 50 Afghans who provide security for the clinic. Two medics are responsible for providing U.S. and allied force health protection, as well as running clinics a few times a week for the local Afghan population since there is no public health ministry presence in the area.

LTC Harrington said there is a huge need for medical training in these areas since there is a high preponderance of violence, trauma, domestic abuse, and accidents. He cited an example of how training has benefitted one particular Afghan medic, who is now able to perform a variety of medical and dental procedures after receiving five years of mentoring by U.S. Special Operations Forces medics. “Mentoring is the only thing that will work for medical personnel in Afghanistan,” LTC Harrington advised. “Many Afghan

(medical) personnel are good and have been trained by SOF medics for several years, so there is the potential to hand off to them when security stabilizes.”

Training Afghan medics will help DoD work its way out of a job in the country. CPT Winschel said “Special Forces commandos and the ANA are providing security in order to do VMOPs to make (Afghan) military units and medical providers better.”

LTC Harrington said MEDCAPs are best done in war zones and can work well if kept simple and one is well-informed about the operational environment. Many of the people in these rural areas have never been seen by their government medical providers.

Since just two SF medics are oftentimes involved in each medical outreach mission, additional civilian support could help achieve a more lasting impact. “We need to provide collaborative care,” CPT Winschel advised. “It can’t be just two SF medics, who are on the ground for six to nine months. A USAID coordinator would be able to manage and assist each SF team that works his/her region to maintain continuity of development along the Afghan government’s guidelines.”

A large percentage of Afghan patients in rural areas are children, and there is a strong need for pediatric and maternal healthcare. LTC Harrington said USAID or an NGO could send physicians out to one of the rural SF clinics for a week or so at a time and have the opportunity to see many patients.

Charles Craft, DDS, USPHS, who was involved with dental projects in recent deployments to Afghanistan, said it is important to set up projects that invite NGO participation, and hand off programs to local management for long-term sustainment. Having Afghans run the projects is vital.

“Don’t try to force our U.S. programs into rural Afghanistan,” Craft advised. “Research what they have. Don’t go in and put in a whole new system. We need basic level providers who have Third World experience. Go in with realistic projects and ones that the people want, not what we want, and not weaken the community because they are too big or too much for them to sustain. Don’t measure success because of the amount of money we spend. Measure it by what’s working.”

By working with local NGOs in Afghanistan, Craft trained a dental team that in turn brought in Afghans from other provinces and trained them. He suggested the best way to succeed and gain knowledge over the long-term is to work with local NGOs and support them. Locally sustainable projects work best, while a new hospital, for example, may not be the best solution.

The Afghan Ministry of Public Health (AMOPH) has also put new guidelines in place for the construction of health facilities to ensure that they can be properly staffed afterwards. Therefore, it is impor-

tant to work with them. “We need to offer them consults when there is a vested interest in building a healthcare clinic, but they need to build their own facilities,” CPT Winschel stressed. “Have the AMOPH approve and build it themselves instead of outside contractors so it is something that empowers local medical providers and local leaders. Newly built clinics need to be owned and operated by the Afghan government. NGOs and IOs have supported such projects around the world and would be very helpful if they could get out to the remote areas to access and consult the AMOPH on how to develop a quality healthcare system throughout Afghanistan. By putting an Afghan face on such efforts to improve the local military units and medical personnel, we hope to legitimize the government. In the interim, there have been great inroads with the VMOPs where we got the local elders and villagers involved. It gave them credibility.”

MAKING IT LOCAL

CPT Winschel cautioned against making too many promises, so that subsequent deployers are not walking into unrealistic demands. “There needs to be expectation management,” he said. “Furthermore, don’t promise treatment until you talk to the local docs to see what the capability is, or what the transportation capability is to Kabul or the nearest large city with a hospital. Long-term care should be avoided in remote areas since sustainability is impossible. You have to be honest and credible if specialty care is not available.”

Dr. Shakir Jawad, an IHD member who was a brigadier general in the Iraqi army and an orthopedic surgeon who cared for several American POWs in OIF, later helped the U.S. begin to rebuild the new Iraqi healthcare system and now provides Middle East health policy expertise for the division. He often speaks of host nations as the “forgotten stakeholders” in stability operations. Working with host country personnel from the beginning to identify what they need and manage expectations is crucial, he said, particularly since their perceptions of U.S. projects are often different than how the U.S. perceives them. Dr. Jawad said stability operations require more developed U.S. government interagency planning, and U.S. transparency and genuineness in its actions. Having clear objectives and assurances of enough funding and that it will be used for its intended purpose are also crucial. He also said it is important to carefully plan projects out before pouring money in, and to think of what the needs and sustainable capabilities are from the local perspective. “Sometimes the host nation doesn’t know how to prioritize what they want,” he said. “We can help, (But) we need to change the way we think.”

A long-term strategy is vital to avoid going in and carrying out medical missions with no follow-up, which can then be viewed by the local population as empty promises. “The U.S. military is just now learn-

ing the value of NGOs,” Craft said. “My advice is to get NGOs in from the beginning (in the planning stage on) and work with them. When there is mutual support and respect (between DoD, NGOs and the local population), the end result is much better.”

International elements can also help, as was the case when CPT Winschel and an Italian doctor from a nearby International Security Assistance Force-Afghanistan NATO unit worked with a SF Commando doctor, an ANA doctor, a local doctor, an X-ray tech, a pharmaceutical tech, and two local female Russian nurses (who had married Afghans and stayed when the Russian army left) in a local facility for several months in remote western Afghanistan. CPT Winschel also flew in an all-female treatment team from Bagram to help. This special team of healthcare providers was utilized by him and the SF medics in other parts of Afghanistan, as well. It put a female face on culturally appropriate care to Afghan women, and provided health education about hygiene and dental care. “A female interpreter helping kids or a female provider respects the culture. We’re not trying to make it like the U.S., but help (through adapting to) their culture,” CPT Winschel said. Likewise, other U.S. Army specialists can work with the local community and ministry of agriculture on projects that contribute to economic development, such as watering plants or teaching in dining facilities. One veterinary specialist said he did that in Iraq while working on provincial reconstruction teams, conducting weekly classes and treatment missions with local veterinarians that had an impact. “There are great agricultural needs and opportunities to teach them how to do for themselves,” CPT Winschel said. “Educational programs are the best bang for the buck. Literacy programs, teaching them how to better brush their teeth, and Veterinary Civic Action Projects (VETCAPS) that protect Afghan livestock, help greatly. We had local veterinarians out there and worked with them. In one particular VETCAP we treated over 1,100 animals while training the Afghan veterinarian how to do it. A good vet can make a big impact in the countryside.”

CPT Winschel stressed the application of innovation to solve problems in the field, such as using the radio to reach people and announce the arrival of medical teams or convince them to bring their goats and cows in for veterinary treatment, for instance. “If we can (also) teach kids how to read and they see there is more out there in the world, they will learn to value education,” he said. “Take a step back and view the process. With a tailgate MEDCAP, we’re trained to think outside of the box. Give the local doc a set of basic dental tools, not an \$8,000 state-of-the-art chair that is not sustainable.”

LTC Harrington said he utilized a unique, lightweight portable dental system that can do 90% of what a large expensive system can, and he flew by helicopter to Afghan villages to provide dental care with it. “There are no dentists at all in these places,” he said.

Dr. Anderson said the ability of SF teams to integrate with villagers helps the mission. "I think just as a SF team might have tactical support, we need to think about having a USAID guy on the team, as well. He can be the development guy for the teams."

At the annual SOMA conference last December, COL Rocky Farr, who served in Vietnam as a Special Forces medic and recently as the U.S. Special Operations Command surgeon, spoke of a civil-military initiative in the early '60s in which U.S. Special Operations medics were sent to villages in Vietnam to perform MEDCAPs and work with USAID. "It was done with taking young men (from the village) to help with the war and (in return) we'll help you with your village," he said. "USAID was there and brought in rice crops, for example, so they didn't have to farm meanwhile. It also worked because it was a persistent presence. You become local."

However, although USAID is the international development lead for the U.S. and has participated in Iraq and Afghanistan civil-military provincial reconstruction teams, there is a shortage of agency personnel nowadays. Dunlop said the cadre of USAID's Foreign Service officers is a mere shadow of what it was during the Vietnam War. "We can contract personnel," he said. "This is something that's not going to be solved soon."

"Sometimes you have to win the hearts and minds of your colleagues, too," CPT Winschel said. "It's important to take a risk. My success in Iraq was I knew how to use my local NGOs and IOs. I was able to get the U.N. to help coordinate the cleaning of the streets and to develop a landfill, for example. We need to get more involved with big, international organizations that are involved or interested in Afghanistan to help long-term. The strategic humanitarian assistance effort in remote villages can have a great long-term impact, but we need more support from international organizations. There are vocational and agricultural needs and opportunities, as well as educational needs. An IO or NGO can help a lot with the development and sustainment of these opportunities."

Another issue CPT Winschel sometimes en-

countered was local bureaucracy and corruption being obstacles to obtain medicine and equipment for the medical outreach programs. The in-country policy is to have the purchases done locally, but he said it was reported that often the locals would get U.S. brands of medicines and sell them in the local market instead of taking the medications. Currently the purchases are done locally to stimulate the local economy, but this also stimulates Iran and Pakistan, where the medicines and medical supplies are produced. Furthermore, the SF teams utilize DoD CERP (Commander's Emergency Response Program) funding for the local purchases, but this tends to take several days to a week to obtain, if not longer. Having an IO come in to help develop a pharmaceutical company to hire locals and stimulate Afghanistan's economy would be a better long-term benefit, he advised. "There is a lot of opportunity for IOs and NGOs to come into Afghanistan, if the security increases, to provide such opportunities and to teach medical skills," he said. "Many Afghans could be trained to do basic healthcare if we get international help, an NGO or IO."

Fred Gerber, of the NGO Project HOPE, said it is important for DoD to think of the consequences of MEDCAPs and dental or veterinary projects, have good measures of evaluation in place instead of just collecting numbers of patients treated, or medicines issued, and to use NGOs as force multipliers. "Anything you do ought to have health capacity built into it, (such as) training the local doctor at the institutional and organizational level in his hospital and network of clinics," he said. "Raising (local) health capacity is what will let you move out of the country."

Former Assistant Secretary of Defense for Health Affairs Dr. S. Ward Casscells attended the recent FHP&R meeting and praised the SF medics for their hard work, risk-taking, and innovation at the tactical and strategic level. "We've not taken enough advantage of IOs and NGOs," Dr. Casscells said. "We're talking about how the U.S. military can be an enabler, a builder, not a breaker."

For more information, please go to (www.fhpr.osd.mil/intlhealth).



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Time for a Change: Recommended MTOE Rank Adjustment for Army Special Operations Physician Assistants

MAJ John F. Detro, PA-C

The U.S. Army is rapidly expanding its Special Operations Forces (SOF) capability to meet the demands of the Global War on Terrorism (GWOT). Due to this expansion, there is a need for more and better-experienced SOF physician assistants (PAs). In 2008, the Physician Assistant Section, Army Medical Specialist Corps (AMSC) updated its Career Life Cycle Model. Career branch managers and individual PAs employ this model to chart career progression. According to this model, Army PAs can serve in SOF units (Appendix A) until reaching the rank of lieutenant colonel (P). The Modified Table of Allowances and Equipment (MTOE) is the Army's organizational structure for assigning individuals and equipment (http://www.army.mil/usapa/epubs/pdf/r570_4.pdf) to a specific tactical unit. Currently, the MTOE within the SOF community only supports hiring of PAs with the rank of captain or major and retention up to the rank of major (exception, the United States Special Operations Command (USSOCOM)). With the need to retain and expand the number of high quality PAs within the community, an MTOE change is required within all Army SOF units. This change will balance the PA life cycle model with actual MTOE allocations within SOF units. The overall effect would be the retention of increased numbers of experienced PAs within the SOF community.

During the 1970s, the U.S. Army was losing many physicians to civilian practice. Due to this shortage, military physicians saw a need for developing a military PA profession. Congress authorized the training of Army PAs and training began in 1971. The first class graduated in 1973. The other Services quickly followed the Army's lead and established their own programs. Later, these programs combined to form one school. Today, the Interservice Physician Assistant Program (IPAP) is the only Department of Defense institution for training military PAs. The IPAP is the largest PA program in the United States with approximately 200 graduates annually. Approximately 115 of the current students are active duty Army.

Today, PAs work in all types of medical and surgical practice environments. Advanced training in formal residencies such as orthopedics, general surgery, and emergency medicine are available. Despite these specialties, the majority of Army PAs serve in combat arms

units. Currently, of the 973 Army PAs serving on active duty, 97% have deployed to combat with an average combined deployment time being 29 months.

Special Operations units conduct unconventional missions in austere environments. Due to the remoteness of these missions and the lack of direct physician oversight, the employment of more seasoned PAs is imperative. Currently, according to Lieutenant Colonel Earl "Buck" Benson, United States Army Special Operations Command (USASOC) Senior PA (personal correspondence), USASOC employs mainly company grade physician assistants. Currently, USASOC and the Joint Special Operations Command (JSOC) are expanding the number of assigned personnel. An increase in SOF rank structure is necessary given the complexity of SOF missions and the investment in training of PAs. By utilizing more experienced PAs, the SOF medical community can decrease the risk of medical errors, medic-training shortcomings, enhance mission planning, and improve patient care.

Assignment in a SOF unit requires that PAs serve one tour in the Regular Army (RA). These tours can range from one to three or more years. Currently, students graduate from the IPAP as first lieutenants or higher (based on prior service) with two years' time in grade. Given no adverse performance, in two years they will become captains. Generally, after eight years serving as a PA, individuals are promoted to major. Given the need to serve a RA assignment, most PAs enter the SOF community as a mid-level captain with two to four years time in grade. Therefore, upon assignment to SOF units, within two to six years these PAs will be majors.

The majority of SOF allocations for PAs are for captains; exceptions include a few major positions within HQ USASOC and JSOC units along with one lieutenant colonel slot at USSOCOM. Upon promotion to major, SOF PAs must make career decisions. Individuals could attempt to obtain one of the few SOF major allocations. If unable to obtain a position for a major, an individual could remain in the lower ranked position. This may be attractive for individuals who are looking toward retirement or plan to leave the service after completing any service obligations. However, for those hoping to remain competitive for promotion to lieutenant colonel, many choose a permanent change of station (PCS), and an assignment to

a conventional position, which prepares them for the next higher rank. Either way, these highly qualified PAs leave the community.

According to the career life cycle model, PAs should move between three career paths: education, leadership, and patient care. The goal of this model is to promote diversification as PAs serve in all three tracks. However, it is possible to stay within one track for longer periods. This model depicts PAs serving in SOF units from approximately their fifth to sixteenth years of PA service. By this standard, individuals could stay within SOF units from the rank of captain until selected for promotion to colonel. However, the current MTOE allocations reflect a different reality. Below is a list of the current allocations by unit. Currently, many majors occupy captain positions. These numbers derive from available MTOE tables (36 PAs with 8 pending) and personal knowledge.

Based on the need for highly experienced PAs within SOF units, the community must change the PA MTOE to support the current life cycle model, PA career progression, and most importantly improve Soldier medical care and operational planning of SOF units. By upgrading the rank structure of PAs within all SOF units, the community will retain more highly qualified PAs for longer periods.

Unit	Number of PAs	Rank	Total
Special Operations Groups Four groups with four battalions each	25 (4 per battalion, 1 Group HQ)	03	25
Special Operations Aviation Regiment (160 th) Four battalions	5 (1 per Battalion, 1 Regimental HQ)	03	5
75 th Ranger Regiment (4 battalions) Three battalions	8 (2 per battalion, 2 Regimental HQ)	03/04	7/1
Joint Special Operations Command	8	03/04	8
Special Operations Command South (SOC SOUTH)	1	03	1
Southern Command (SOUTHCOM)	1	03	1
U.S. Special Operations Command (USSOCOM)	1	05	1
John F. Kennedy Special Warfare Center & School	1	03	1
Special Warfare Center & School (SWCS)	1	03	1
Special Operations Medical Detachment (SOMEDD) (Formerly 528 th Sustainment Brigade)	1	03	1
U. S. Army Special Operations Command (USASOC)	1	04	1
Totals	53	49/3/1	

The following is a proposed list of changes:

- **Special Operations Groups:** Upgrade all battalion slots to 04 and Group slots to 05.
- **Special Operations Aviation Regiment (SOAR):** Upgrade battalion slots to 04 and the Regimental position to 05.
- **Ranger Regiment:** Upgrade battalion slots to 04 and Regimental Senior PA to 05.
- **Joint Special Operations Command:** Upgrade all slots to 04 with two slots upgraded to 05.
- Upgrade USASOC/USSOCOM positions to 06, remaining positions upgraded to 04.

The net outcome would represent a change from 49/3/1 captains/majors/lieutenant colonels to 42/9/2 majors/lieutenant colonels/colonels.

There are several advantages to these MTOE changes. These advantages benefit both the SOF community and Army Medical Specialist Corps (AMSC). First, upgrading the SOF PA rank structure balances the life cycle model with the MTOE. By increasing this PA rank structure, the Special Operations Command will gain forty-two majors, nine lieutenant colonels, and two colonels. Despite the junior positions being 04, the community can still hire PAs as 03s.

Many PAs elect to retire or leave the service when they can no longer serve in SOF positions. This increase in rank allocation will allow these individuals to remain in community for increased periods and will likely lead to longer service careers. In addition, these individuals will provide the SOF community with more experienced providers and medical planners. At the same time, retention in the community should not negatively affect an individual's career, as the PA will serve in positions commensurate with their rank. Like other officers, PAs could choose to make a career within the SOF community.

These changes also benefit the AMSC. By increasing senior PA MTOE allocations, the AMSC has more ability to progress individual PAs to senior positions. Presently, the number of lieutenant colonel MTOE/TDA positions is minimal at 29. In addition, the majority of these positions are in Table of Distribution and Allowance (TDA) units. By increasing the number of SOF allocations, this will increase lieutenant colonel positions by nine. These nine positions would all be MTOE allocations. In addition, the AMSC and SOF community would gain two PAs with the rank of colonel, who would serve in MTOE positions. Thus, promotion potential would greatly improve.

With every change, there are negative consequences. Changing the MTOE and allowing individuals to serve longer in SOF units could lead to a lack of diversification secondary to fewer PCS movements and decreased job variety. In addition, PAs may elect to stay in the community and decline attendance at specialty training programs such as orthopedics, emergency medicine, or general surgery. Eventually, as the community catches up on hiring shortages and institutional change, more individuals will likely stay in the community longer. This situation may decrease the opportunity for new personnel to enter into SOF positions.

The SOF medical community has not addressed the current PA MTOE and career life cycle model discrepancies that currently exist. If MTOE changes do not

occur, many highly qualified SOF PAs will make decisions between returning to the Regular Army for career progression, leaving the Army, or deciding to stay in a position below their rank. If needed MTOE changes occur, PAs will not have to choose between career progression and SOF careers.

Obviously, the Army needs SOF PAs to serve in conventional assignments. However, the SOF community needs to keep a percentage as well. For change to occur, physicians within the community must support this effort. In addition, the key to success is for the dissemination of this information to SOF commanders who can facilitate change. Colonel Michael Robertson, Section Chief, Assistant Corps Chief AMSC and PA Consultant to the Surgeon General, and his successor, Lieutenant Colonel John Balser, are both in support of a change in MTOE rank structure within the SOF medical community. As a community, we must take advantage of his efforts to support us.

According to the 2008 SP Year in Review article, the AMSC has made more groundbreaking changes <https://www.us.army.mil/suite/portal/index.jsp> than ever. Changes involving Army PAs include an increase of PA slots in the Ranger Regiment from four to eight, development of new specialty programs (general surgery), development of Doctor of Science degrees in orthopedics and emergency medicine, and many improvements to include PAs commanding Forward Surgical Teams (FST) and Combat Support Hospitals (CSH).

The SOF medical community has a unique opportunity to continue this trend by making these recommended MTOE changes, which will increase SOF medical capability. There are many steps needed to make this happen. First, senior physicians within the respective commands must endorse this plan and educate leaders regarding the importance of retaining high quality, experienced PAs. Through education, commanders and physicians can drive this change in rank structure. By empowering individual units, physicians and commanders can request MTOE changes through Force Design Updates (FDU) via command channels to include both USASOC and JSOC.

The SOF medical community should strongly consider increasing the MTOE rank of all PA positions. This transformation will benefit USSOCOM, AMSC,

and the U. S. Army. Through an increase in rank structure, PAs will serve longer within the command and military. In addition, they will provide a higher level of medical expertise and leadership. Starting with AMSC Year Groups beginning in 1997 (Appendix B), there remain much higher numbers of majors than positions for promotion. Currently, there are over 40 members. Given that each year 1-5 AMSC officers attain the rank of lieutenant colonel, the ability of PAs to attain this rank is limited. By increasing the number of field grade positions within SOF units, the SOF community will gain a more experienced provider and the AMSC will acquire an additional forty-two majors, six lieutenant colonels, and two colonels.

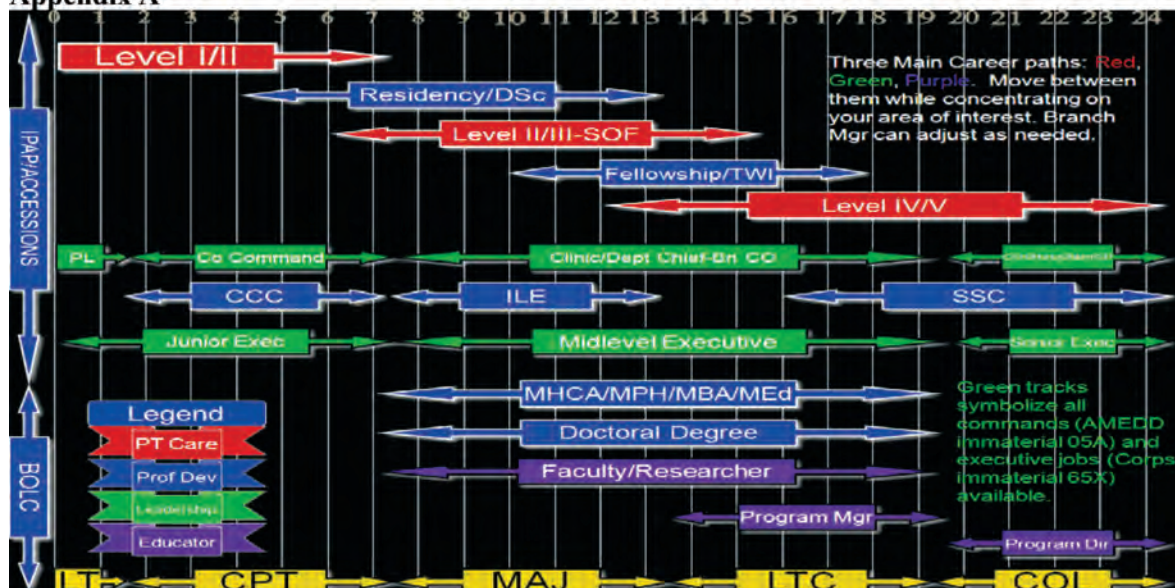
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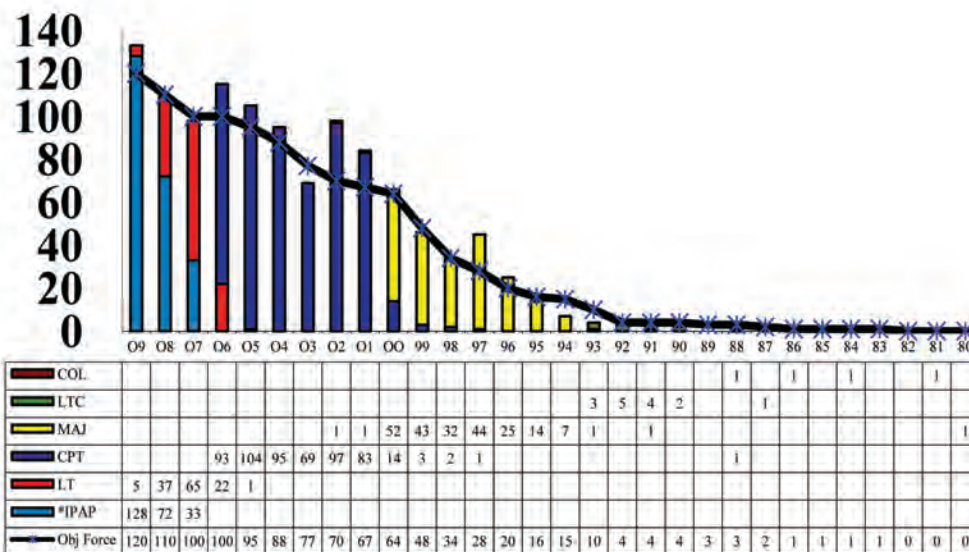
Appendix A



U.S. Army Physician Assistant Career Life Cycle Model

Appendix B

Year Groups pending future promotion to Major (00-05) and Lieutenant Colonel (96-99) are both well above 100% of allocated end strength numbers.



MAJ John Detoro served two tours with 3/75 Ranger Battalion as a Battalion Physician Assistant. MAJ Detoro has six combat tours for the current conflicts plus one prior combat tour to Desert Storm. He is currently attending the Intermediate Level Education Course, Fort Leavenworth, Kansas.

Suspected Dietary Supplement Injuries in Special Operations Soldiers

MAJ John Hughes, MC; SSG Byron Shelton, 18D;
Maj Teresa Hughes, BSC

ABSTRACT

Evidence suggests that a number of Special Operations Soldiers are using dietary supplements to augment their physical training programs and that some of these supplements are not entirely benign. This article presents a series of case reports of Soldiers who suffered adverse effects that may be at least partially attributable to the use of dietary supplements. Given that many Special Operations Soldiers train at the same level as world class athletes and the use of supplements is common among world class athletes, the use of supplements is not likely to stop. To this end, the purpose of this article is to provide awareness of the problem, discuss some of the harmful effects of dietary supplements, make a recommendation for education to help reduce the number of injuries resulting from the use of dietary supplements, and recommend that scientific studies be done to prove the benefits and risks of taking dietary supplements.

INTRODUCTION

The Dietary Supplement Health and Education Act of 1994 stated that responsibility for the safety of dietary supplements lies with private manufacturers, not the Food and Drug Administration (FDA). In other words, the FDA does not regulate dietary supplements for safety and efficacy before they are marketed. Additionally, the FDA does not evaluate the validity of their claims of enhancement. Consequently, individuals may be putting themselves at risk for unknown benefits if they have little understanding of the product's ingredients, if they do not use the product according to the package instructions, and/or if several products are used in combination. Just as with prescription medications and illegal drugs, any substance introduced to the body can have adverse consequences. Additionally, consumers must trust that the labeling on the package is accurate and/or do their own in-depth research to determine the potential risks of taking a particular supplement or a combination of supplements. However, for simplicity, the authors grouped these substances together in this article since the Soldiers were using substances for one goal: performance enhancement. The authors recognize that some of the various substances discussed in this article are categorically different from each other. For example, ergonomic aids are used to enhance performance, but are not typically referred to as supplements. Anabolic steroids are illegal and designed to enhance muscle growth. Finally vitamins are considered supplements and are mostly benign, even if taken in excessive doses.

There is a non-profit, non-governmental organization, NSF, that has a multifaceted certification process that verifies that dietary supplement makers are using good manufacturing practices. Athletes can use NSF certification to feel confident that the product label accurately describes the substances contained in the product. However, even this is not all-inclusive as the NSF does not conduct scientific research to determine the efficacy of the product, to validate recommended dosages, or to study adverse effects. Additionally, the NSF will not certify illegal or banned substances such as anabolic steroids or steroid precursors.

This may be of particular concern to the U.S. Army since injuries resulting from the use or misuse of supplements can directly affect a servicemember's deployability. Supplement use is common across the Army. Additionally, anabolic steroids, which are illegal, are also used by a small number of Soldiers. According to research conducted by Johnson et al. in the 2007 *Journal of Special Operations Medicine*, 37% of U.S. Army Rangers who responded to a survey indicated they used dietary supplements. The most frequently used agents were protein (63%), creatine (45%), thermogenics (44%), androstenedione (27%), amino acids (8%), and anabolic steroids (1.8%). The article also cited that the most common sources of information about the dietary supplements were other Soldiers (59%), fitness magazines (46%), and the internet (18%). The authors discussed the effects of the supplements, but did not elaborate on any observed ill effects or in-

juries from the use of the dietary supplements.¹ In 1999, a survey of 2,212 males (ages 18-47 years) undergoing Ranger and Special Forces training revealed that 64% were using training supplements. In 2002, a survey of enlisted Soldiers in the conventional Army stationed in the continental United States showed that 65% were using dietary supplements.² Given the reported high level of use of supplements in the Johnson et al. article, it can be inferred that supplement use is

similarly widespread in comparable Special Operations units, although the results may not be generalizable to conventional units.

United States Special Operations Command (USSOCOM) Policy Memorandum 08-01 prohibits all supplement use for students going to specific Special Operations schools and also prohibits the use of any supplement specifically banned or made illegal by the FDA or US law. For the remainder of supplements, it

Summary of Supplement-Attributable Injuries

GENDER	SUPPLEMENTS USED	CHIEF COMPLAINT (Why patient came to sick call)	INJURY SEEN	OUTCOME
Male (deployed)	Steroid patch Steroid injection Steroid pills Protein Creatine	Patient self-referral for lab work due to concerns resulting from supplement use	↑ liver transaminases ↑ creatinine	1. Lost time (admin duty 3-4 months) 2. Resolved with cessation of supplements and rest
Male (deployed)	Protein Creatine	Peripheral edema	↑ liver transaminases ↑ creatinine Peripheral edema	1. Redeployed 2. Resolved with cessation of supplements and rest
Male (deployed)	Protein Creatine	Hypertension	↑ liver transaminases ↑ creatinine	1. Sent to Landstuhl 2. Resolved with cessation of supplements and rest
Male (deployed)	Mass tabs Muscle Milk NO Xplode™ Megaman MVI™	Jaundice	Cholestatic jaundice Liver Failure Kidney Failure Nearly required liver transplant	1. Redeployed back to home station for evaluation and management 2. Ongoing – not resolved
Male (deployed)	Protein Creatine	Rectal bleeding workup	↑ creatinine	1. Resolved with cessation and rest
Male (deployed)	Multiple supplements (unknown types)	Fatigue	↑ liver transaminases ↑ creatinine	1. Lost time 2. Resolved with cessation of supplement and rest
Male (deployed)	NO Explode™	Palpitations	Palpitations	1. Lost training time (1 week) 2. Resolved with cessation and rest
Male (deployed)	Protein Mass tabs™, isopure (anabolics)	Fatigue	↑ liver transaminases ↑ creatinine	1. Sent to Landstuhl 2. Resolved with cessation of supplements and rest
Male (garrison)	Anabolics Protein Milk thistle	Periodic physical exam	↑ liver transaminases ↑ creatinine	1. Training time lost doing evaluation 2. Ongoing – not resolved
Male (deployed)	Denied supplements	SOF school physical	↑ liver transaminases ↑ creatinine	1. Training time lost for evaluation 2. Resolved with cessation of supplements and rest
Male (garrison)	Protein supplements	Routine physical exam	↑ liver transaminases	Resolved with cessation of supplements and rest
Male (garrison)	Tren™ - anabolic precursor	Breast mass	Breast mass	Surgery to remove mass
Male (garrison)	Animal™ - anabolic precursor	Breast mass	Breast mass	Pending surgical consult
Male (garrison)	Denies steroids	Breast mass	Breast mass	Lost time for evaluations
Male (deployed)	Denies steroids	Breast mass	Breast mass	Lost time for evaluations
Male (deployed)	Denies steroids	Breast mass	Breast mass	Redeployed

recommends that service members educate themselves before use. As of the writing of this article, SOCOM is revising this policy. The authors could not identify any other existing policies within USSOCOM or the U.S. Army Special Operations Command (USASOC) that would regulate supplement use.

Case reports of supplement injury are found sporadically in the literature, but most are deduced through indirect data. Few, if any, prospective controlled trials directly measured the injuries and most of these are performed in animal studies. This article also presupposes adverse effects were directly related to supplement use since most of the Soldiers reported the supplement used and the symptoms resolved in most cases after the Soldier discontinued the use of supplements.

From June 2007 to November 2009, several of the authors of this article twice served as providers to a Special Operations task force of approximately 500 personnel who deployed to Operation Enduring Freedom. During the two-year period, the providers treated patients in a walk-in protocol for the deployed task force and its multi-service Special Operations attachments while deployed and in garrison. The case series that follows presents adverse effects sustained by Soldiers during deployment and in garrison. References to Soldiers are intentionally ambiguous to protect the patients' confidentiality. The substance used is in most cases generic as many patients would not elaborate further on the substances they were taking. The Chief Complaint listed is the reason for the patient encounter. Often, the reason was unrelated to dietary supplements and the issue did not emerge until lab testing was done for another reason or to investigate possible end organ effects after concerning information emerged in the history that was unrelated to the chief complaint.

DEMOGRAPHICS

All patients were active duty, Army Special Operations males between ages 20 and 45. Physical training experience levels of the Soldiers injured by supplements varied from very experienced bodybuilders to novice athletes.

Notably, the four Soldiers who denied using supplements (specifically steroids) were suspected of misrepresenting their use based on the results of physical exams, their body habitus, and the presence of breast masses, which can result from steroid use.

Most of the injuries were reported and/or occurred in deployed environments during the summer and early fall when the weather was very hot and dry. Extremely high ambient temperatures place additional stress on the body during physical training by amplifying the rise in body temperature and accelerating dehydration. These training environments may have exacerbated the negative effects of some of the dietary supplements, particularly protein and creatine which are

processed through the kidneys and work by raising body temperature and stressing the cardiovascular system. Research on creatine suggests that when used properly, not in combination with other substances, and for short durations it does not cause dehydration, alter thermoregulation,³ or induce kidney dysfunction.⁴ However, little if any research has been done on the long-term effects of creatine, particularly creatine used in higher doses, with other agents, and/or in extreme heat environments. Additionally, most ill effects did not occur with the appropriate use of one agent in isolation. Except for the thermogenic dysregulation and the hormonal fluctuations, all other injuries resulted from the use of multiple agents and are likely the result of the cumulative stress of multiple supplements on the body resulting in organ damage. Fortunately, in all but two cases, the organ dysfunction resolved after several weeks or months of rest and discontinuing the use of the supplements.

The authors acknowledge that elevated lab values do not necessarily constitute injury. Most adverse effects to the liver and kidney were transient but persisted for weeks or months, associated with use of more than one type of supplement, involved use of larger than recommended doses of supplements, and resolved with cessation of the supplements and rest. The injured personnel were otherwise healthy, resilient young males. The concern is that prolonged use of these supplements was associated with persistent elevations of kidney and liver labs and could lead to irreversible organ damage (one Soldier nearly had to have a liver transplant). That being said, the injured Soldiers frequently had to undergo medical testing or evacuation to fully define the scope of injury. This took the Soldiers out of combat or training and placed additional strain on their units.

In late 2009, the FDA added 71 prohormone supplements to the list of recalled supplements. This article still discusses both steroid and prohormone supplements because Soldiers determined to obtain these supplements will find a means of obtaining them. Furthermore, these substances are widely offered on the internet and supplement companies are quick to offer alternative prohormones and supplements that have different brand names or formulations. The authors of this article acknowledge that anabolic steroids are illegal and do not condone or endorse their use; rather they discourage Soldiers from using them. However, medical personnel still need to be aware of their usage to better counsel Soldier athletes, spot adverse effects, and recognize when Soldiers may be using them in dangerous dosing regimens.

The authors encountered many younger Soldiers who began using a variety of health supplements with little to no knowledge of how they work, how much to ingest, and how often to use them. The authors dealt with these Soldiers by providing education and guidance. The remainder of this article is a compilation and expansion of the education provided to these Soldiers.

PREVENTIVE MEASURES

Restricting supplements through command policy or manipulation of base store policy will most likely fail to curtail supplement use. Soldiers invariably will find a way to get them, especially with the widespread availability of supplements on the internet. Even illegal anabolic steroids are relatively easy to obtain and were used by a fair number of patients seen by the providers. Instead, education will be the most effective countermeasure. Soldiers are inundated with information about dietary supplements on television, the internet, friends, and other athletes. Some information is accurate; much is not. The key will be to find methods for disseminating the most accurate information on proper supplement use, the risks of using supplements, and how to recognize the warning signs of adverse effects to those most likely to use supplements.

Providers in the Special Operations units (physicians, physician assistants, physical therapy specialists, dietitians, and medics) must be educated on health supplements in order to best help their patients. Further, they have to be aggressive in asking Soldiers about usage. Many patients will not volunteer this information due to lack of understanding of any connection to an illness and/or a fear of repercussions of using supplements.

Even more effective, though, will be a deliberate campaign to get information to the Soldiers and their most powerful advisors – their peers. Attached is a proposed information chart of common dietary supplements, the manufacturers' recommended usages/dosage, and the adverse effects of each. The recommended uses and dosages are based on manufacturers' recommendations; there is scant scientific data to support their use and dosage claims. The manufacturers' recommendations are included because many of the injuries were

seen in soldiers who exceeded these recommendations in dosage, duration, or both for long periods of time, intending to accelerate their gains.

Additionally, the Army Office of the Surgeon General Policy on Medical Screening for Dietary Supplement Use, published on 1 May 2000, directs Army health care providers to obtain information about dietary supplement use while taking patient history information and ensure that the information is charted on the Standard Form (SF) 600. Also, it directs Army healthcare providers to report adverse events ("fatal, life-threatening, permanently/significantly disabling, requires or prolongs hospitalization, or requires intervention to prevent impairment or damage") to the FDA at (<http://www.fda.gov/medwatch/how.htm>). Further, in accordance with the Army Office of the Surgeon General Policy published 12 September 2002, any use of dietary supplements connected to a heat injury is to be reported through the Army Reportable Medical Events System (RMES).

COMMON DIETARY SUPPLEMENTS USED BY ATHLETES

The following provides for informational and educational purposes only a relatively comprehensive list of commonly used dietary supplements. No endorsement of any of the products is intended. All Soldiers should consult with a health care provider prior to beginning any new supplement or workout regimen. Additionally, all medics, physician assistants (PAs), physical therapists (PTs), surgeons, dietitians, etc. should be familiar with these products to ensure their patients use them correctly and inform the Soldiers on proper usage and dosing, adverse effects, and contraindications. Ideally, information on common supplements should be taught to the medics at least annually.

SUPPLEMENT and DESCRIPTION	RECOMMENDED USAGE	RECOMMENDED DOSAGE	ADVERSE EFFECTS
ANABOLIC STEROIDS - Are related to testosterone, which increases the protein synthesis within a cell. The result of increased protein synthesis inside of cells is the increased rate of anabolism (the process of building) or increasing the amount of energy consumption by the body.	MEDICAL USES - To stimulate bone growth and appetite, treat chronic wasting conditions such as cancer and AIDS, and for Hormone Replacement Therapy (HRT). ATHLETIC USES - To increase hypertrophy, strength, aggressiveness, and energy.	NOTE: Non-medicinal anabolic steroid use is illegal in the U.S.! DOSAGES- Dependant on which anabolic is utilized. (i.e., Dianabol, Winstrol, Halotestin, etc.) For MEDICINAL DOSAGES- The physician will determine the proper dosage for the patient. For ATHLETIC DOSAGES- It is recommended that users consult a physician prior to beginning any anabolic regiment to determine if they are in proper health. Cycling on and off is a MUST to decrease the adverse side-effects.	SIDE-EFFECTS ARE COMMON WITH ANY ANABOLIC STEROID *Inhibition of natural hormones/sterility *Hypogonadism *Increased work load on kidney and liver leading to adrenal and hepatic failure *Increased low-density lipoprotein (LDL) with decreased high-density lipoprotein (HDL) *Increased blood pressure (BP) and cardiovascular illnesses *Gynecomastia *Enlarged Prostate *Acne w/possible baldness *Stunted Growth
PROHORMONES (i.e. TESTOSTERONE BOOSTERS) - Essentially, these are substances that the body converts to anabolic steroids. There are no studies that demonstrate product effectiveness or all the possible effects of using these supplements. * Tren X-Treme (aka. P-Tren, extreme tren, trenbolone) or 19-norandrosta-4, 9diene-3, 17-dione-30 * Novedex X-T or dianestrozole 3,6,17-androstenetrione * Mass Tabs- Stenbolone w/ tribulus terrestris * Methyl 1-D- 146-etioallocholan-dione	NOTE: The FDA recalled 71 of the prohormones in 2009. ATHLETIC USES- To increase hypertrophy, strength, aggressiveness, and energy. Since these prohormones crossover with steroid detection tests, users may have a positive lab result for steroids. Although the FDA recalled 71 prohormone supplements, many more are still available. Manufacturers have already modified the names of the recalled products to continue sales.	* Tren X-Treme Dosage - Take 1 capsule every 8 hours. Do not exceed 3 capsules per day. Take for a maximum of 6 to 8 weeks, then stop for at least 4 weeks before starting again. * Novedex X-T Dosage- Take 2 to 4 capsules of Novedex XT at night. For best results, use Novedex XT for 4 to 8 weeks. Do not exceed 8 weeks of continuous use. Stop for at least 4 weeks before starting again. * Mass Tabs Dosage- Take one tablet every day for no more than 4 weeks, 30 minutes prior to training. * Methyl 1-D Dosage- Take 4 to 6 capsules per day in two divided doses for 4 to 6 week cycles.	SIDE-EFFECTS ARE COMMON WITH ANY PROHORMONE BUT SOME MORE THAN OTHERS. *Inhibition of natural hormones/sterility *Hypogonadism *Increased workload on kidneys and liver leading to renal and hepatic failure *Increased LDL w/decreased HDL *Increased BP and cardiovascular illnesses *Gynecomastia *Enlarged Prostate *Acne *Baldness *Stunted Growth

<p>NATURAL TESTOSTERONE ENHANCERS (i.e. HERBS) - *Yohimbe Bark Extract- Stimulant and aphrodisiac primarily used to increase a male libido. It is found naturally in the yohimbe plant. *Tribulus Terrestris- Stimulant and aphrodisiac primarily used to increase male libido. It is found naturally in a perennial plant. *NOTE: Either of these supplements can be purchased by themselves, but they are commonly mixed together (example- Liquid MoJo) for a presumed enhanced effect. Neither of these supplements has shown any increased anabolic effect.</p>	<p>MEDICAL USES - *Yohimbe Bark Extract- Can be utilized to stimulate traumatic event recall in patients with PTSD, but is mainly used to increase sexual libido, and can be used to treat sexual exhaustion or sexual dysfunction. *Tribulus Terrestris- Primarily used for increasing sexual libido, but is also used as a natural diuretic and to treat hypertension. ATHLETIC USES- *Yohimbe and Tribulus- Utilized for promotion of testosterone enhancement, which will in turn increase muscle mass, strength, and energy.</p>	<p>*Yohimbe Bark Extract and Tribulus Terrestris Dosage - There are no dosage protocols established for either of these supplements. It is suggested to start low and slowly progress up to the product labels suggested dosage.</p>	<p>Yohimbe Bark Extract - *Tachycardia *Hypertension *Overstimulation *Insomnia *Panic attacks *Hallucinations *HA, dizziness *Skin flushing *Renal failure *Seizures Tribulus Terrestris - Adverse effects from supplements are rare and tend to be insignificant. However, some users report an <u>upset stomach</u>. Another rare side-effect which has been reported is <u>gynecomastia</u></p>
<p>ESTROGEN BLOCKERS - Used to inhibit the synthesis of estrogen, which is a by-product of taking certain supplements, and is usually used in conjunction with prohormones and anabolics. The side-effects are different depending on which type of blocker is used.</p>	<p>MEDICAL USES - Research shows that they can be used to reduce hot flashes, reduce the risk of osteoporosis, treatment of mastalgia, gynecomastia, and treatments for breast, ovarian, and prostate cancer. ATHLETIC USES - To reduce the side-effects of using anabolic steroids or prohormones.</p> <p>NOTE: The authors had a novice bodybuilder approach them about the merits of taking this class of dietary supplements after reading about it in a magazine. He didn't know it was taken to counter anabolic steroid effects, didn't know the possible side-effects of taking it, and didn't even know how the substance worked.</p>	<p>NOTE - These medications are discouraged for athletic use. DOSAGES- Depends on which estrogen blocker is utilized. (i.e., antiestrogens, aromatase inhibitors, or specific estrogen receptor modulators) MEDICINAL DOSAGES- The physician will determine the proper dosage for the patient. ATHLETIC DOSAGES- Prospective users should consult a physician prior to beginning any estrogen regiment to determine their health and need. The doses are still controversial. Products vary based on type of blocker used. Make sure to follow the directions on each label. Cycling on and</p>	<p>SIDE-EFFECTS ARE COMMON WITH ANY ESTROGEN BLOCKER BUT SOME MORE THAN OTHERS. THESE ARE A FEW OF THE MORE SERIOUS SIDE-EFFECTS. *Blurred vision *Bruising *Angina *Dizziness *Fatigue *Hot flashes *Mood swings *Night sweats *Numbness *Edema *Osteoporosis *Arthritis/Arthralgia *Joint weakness *Cerebrovascular accident (CVA)</p>

		off is necessary to decrease the adverse side effects.	
<p>VASODILATORS (e.g. L-Arginine)- L-Arginine is utilized by the body to create more Nitric Oxide (NO) which relaxes smooth muscle within the vessel walls causing vasodilation or an increased circumference of the vessels. There are multiple studies for medicinal uses and side effects of NO but no research on the efficacy of the product's claimed usage.</p> <p>*NO-Explode- BSN product that is mixed with various other supplements (e.g., caffeine, creatine, and aminos).</p> <p>*Nitrix- BSN product containing fewer other supplements than NO-Explode</p> <p>*Superpump 250- Gaspari product that is comparable to NO-Explode.</p> <p>*Super Charge- Lee Labrada product that contains various other supplements including a proprietary blend.</p>	<p>MEDICAL USES- The over the counter (OTC) L-arginine isn't used medically. Medical grade nitric oxide is used for treatment of angina, strokes, hypertension, PAH (Pulmonary Arterial Hypertension), and CHF (Congestive Heart Failure).</p> <p>ATHLETIC USES- Causes vasodilation and increases heart contractility, allowing more nutrients, hormones, and supplements to be absorbed at a faster rate, and increased endurance and energy levels.</p>	<p>*NO-Explode Dosage- Once the user's tolerance has been established, mix 1-3 scoops with 5-18oz of cold water and consume 30-45 minutes before training. Use approximately 5-6oz of water per 1 scoop of powder.</p> <p>*Nitrix Dosage- Take 3 tablets 3 times daily. Take on an empty stomach (i.e. approximately 30-45 minutes before meals or 2 hours after a meal). Take first 3 tabs before lunch, and final 3 tabs before dinner.</p> <p>*Superpump 250 Dosage- Take 1-3 scoops with 4-12 oz. of cold water or juice 30-40 minutes prior to training. Start by using (1) scoop to assess tolerance. Do not exceed (3) scoops at any given time.</p> <p>*Super Charge Dosage- Mix 1 or 2 scoops with 10-16 oz of water. Take on an empty stomach 15 minutes prior to working out.</p>	<p>SIDE-EFFECTS ARE COMMON WITH ANY VASODILATOR. SOME HAVE INCREASED RISK DUE TO ADDITIVES.</p> <ul style="list-style-type: none"> *Hypotension *Tachycardia *Palpitations *Arrhythmias *Angina *Headache *Nausea / Vomiting *Dizziness *Edema *Bloating *Pruritis *Arthralgia
<p>THERMOGENICS- Stimulate the body's metabolism. Only those individuals already on a diet/exercise plan, who have fewer carbohydrates readily available to be metabolized will use a higher percentage of their free fatty acids. Common thermogenic substances are caffeine (regardless of source; i.e. guarana seed extract, yerbe mate, tea, etc.), ephedra, synepherine, bitter orange, and ginger.</p>	<p>ATHLETIC USES- Induce weight loss or increase endurance by increasing metabolic rate, generating and increasing heat, and requiring more energy used from food sources to maintain homeostasis. This information is based on the general claim of athletic articles. Research to substantiate these claims has not been effectively accomplished. However, the research does suggest that the stimulants increase</p>	<p>*Xenadrine RFA-X Dosage- Take 3 liquid capsules with glass of water 2 times daily, DON'T EXCEED 6 CAPS IN A DAY, approx. 30 to 60 minutes before meals. On days of workout, take one serving before your workout. Consume ten glasses of water per day.</p> <p>*Lipo 6 Black Dosage- Take 3 caps in the morning and 3 caps in the afternoon. Do not take within 6 hours of sleep. NEVER EXCEED 6</p>	<p>SIDE-EFFECTS ARE COMMON WITH ANY THERMOGENIC. SOME HAVE INCREASED RISK DUE TO ADDITIVES SUCH AS EPHEDRINE.</p> <ul style="list-style-type: none"> *Tachycardia *Palpitations *Hypertension *Anxiety/Nervousness *GERD/Esoophagitis *Polyuria *Hyperreflexia *Insomnia *Caffeine Tolerance <u>Caffeine withdrawal which</u>

<p>*Xenadrine RFA-X- CytoGenix product that contains caffeine, yohimbe, and a proprietary blend</p> <p>*Lipo 6 Black- Nutrex product that contains caffeine and yohimbe, and a proprietary blend.</p> <p>*Metabolife Extreme Energy- Contains guarana, yerba mate, green tea extract. All of these ingredients contain caffeine and theophylline, a strong cardiac stimulant.</p>	<p>endurance and body temperature due to increased heart rate and BP.</p>	<p>CAPS PER DAY. For maximum results do not take with meals. Consume at least 30 minutes prior to a meal. Use in cycles. A max cycle of 8 weeks followed by a 4 week off-period.</p> <p>*Metabolife Extreme Energy Dosage- Take 1 or 2 caplets 3 times per day with a glass of water. Space each serving at least 3 or 4 hour apart and do not exceed 2 servings in any 8-hour period.</p>	<p>can lead to:</p> <ul style="list-style-type: none"> *Headache *Irritability *Inability to concentrate *Drowsiness <p><u>Caffeine intoxication can lead to:</u></p> <ul style="list-style-type: none"> *Delusions *Hallucinations *Psychosis
<p>PROTEINS (i.e., SOURCES IN POWDERS)- Composed of essential amino acids involved in almost every role within a cell.</p> <p>*Whey protein- Most common type of protein with the highest amounts of essential amino acids. It is absorbed easily and quickly. Therefore, it is best utilized immediately after physical activity.</p> <p>*Casein protein- (or Milk protein) has the highest amount of glutamine, which aids in recovery, and is best used either post workout or before bed. It is absorbed by the body over a longer period of time.</p> <p>*Soy protein- Is an alternative protein for vegetarians that contains all the essential amino acids.</p> <p>*Egg protein- Is a lactose- and dairy-free protein alternative for those who are lactose intolerant. It is also absorbed quickly and easily, but not as quickly as the whey protein.</p>	<p>ATHLETIC USES- Protein is the essential building block for muscle. Protein powder supplement intake in sufficient amounts allows for increased efficiency of growth and repair of muscle tissues broken down during exercise. Consuming complete proteins is preferred to incomplete proteins.</p>	<p>DOSAGES FOR ALL TYPES OF PROTEINS COMBINED REGARDLESS OF THE SOURCE- Proper dosage of protein supplements is a controversial topic. Some articles for bodybuilding and athletic performance state that you can take up to 2g per pound of bodyweight. However, there has not been research substantiating manufacturers' claims. Users should be aware of the effects of overdosing. Taking between 0.5 to 1g per pound of bodyweight has shown sufficient results. Users should consume servings at approximately 3-hour intervals for best absorption.</p>	<p>OVERUSAGE</p> <ul style="list-style-type: none"> *Increased workload on the liver *Kidney Disease *Kidney Failure <p>UNDERUSAGE ACCOMPANIED BY (MALNUTRITION)</p> <p><u>Kwashiorkor which has signs and symptoms of</u></p> <ul style="list-style-type: none"> *Edema in the presence of malnutrition *Anorexia/Weight Loss *Inadequate Growth *Thinning Hair

<p>CREATINE- Is a nitrogenous acid, synthesized from 3 specific amino acids, that is mainly processed in the kidneys and liver, and most of it is stored in skeletal muscle as phosphocreatine which binds with adenosine diphosphate (ADP) to increase the amount of adenosine triphosphate (ATP), or energy source in muscle. Fish, meat products, and supplements are the primary sources of creatine.</p> <p>NOTE- Anyone with kidney or liver disease should avoid use of this supplement. Anyone with diabetes or hypoglycemia should use with caution.</p> <p>TYPES- There are several types of creatine supplements (i.e. creatine monohydrate, creatine ethyl ester). Numerous companies sell creatine products. Some claim is the ethyl ester is absorbed much faster than the monohydrate but no significant evidence is available to substantiate this claim. Follow guidelines on the labels. Most of the products contain extra carbohydrates, vitamins, minerals, and amino acids (i.e. BSN Cell Mass, Gaspari Size On) unless the user buys pure creatine powder.</p>	<p>MEDICAL USES- Scientific research substantiates the use of creatine to treat Congestive Heart Failure patients. Evidence does not substantiate the claims that it is efficacious in treating depression, apnea, Chronic Obstructive Pulmonary Disease, Myocardial Infarction, Coronary Heart Disease, muscular dystrophy, Multiple Sclerosis and neuromuscular disorders.</p> <p>ATHLETIC USES- Athletes often use creatine supplements to increase mass, strength, performance and endurance. Research supports the claims of increased muscle mass and strength but does not support the claims of increased endurance and performance.</p>	<p>DOSAGES- For adults over the age of 18. It is recommended that all users consult a physician before starting any these supplements.</p> <p>MEDICAL DOSAGES- The physician will determine the proper dosage for the patient.</p> <p>ATHLETIC DOSAGES- The loading dose of 5g taken 4 times a day for 5-7 days is controversial. Some researchers recommend beginning with the loading dose and then going to a maintenance phase of 2-5g per day while other researchers believe that users should start with the maintenance phase and skip the loading doses.</p> <p>REMEMBER- Talk to your physician prior to starting any regimen and stay hydrated while using this supplement.</p>	<p>SIDE-EFFECTS ARE COMMON OF ANY CREATINE SOURCE USED-*Heart attack (HA) *Nausea *Diarrhea *Stomach Discomfort *Dizziness/Syncope *Anxiety/Nervousness *Thirst/Dehydration (disputed) *Heat Intolerance (disputed) *Electrolyte Imbalances *Muscle Cramps</p>
<p>GLUTAMINE- A non-essential amino acid that is the most abundant in the human body and one of the few substances that can cross the blood brain barrier. It is found in the blood stream, skeletal muscle, and lungs. It</p>	<p>MEDICAL USES- Animal and clinical studies have shown it is beneficial for wasting diseases (i.e. HIV/AIDS, anorexia), GI diseases and illnesses (i.e. peritonitis, gastric ulcers), injuries, trauma, burns, and</p>	<p>DOSAGES- All adults and children should consult a physician before starting this supplement.</p> <p>MEDICAL USES- The physician will determine the proper dosage for the patient.</p>	<p>THERE ARE NO ADVERSE SIDE-EFFECTS REPORTED IN CLINICAL OR LABORATORY STUDIES</p>

<p>functions as an anabolic aid to recovery by improving the immune system function and response to infection, and is needed for proper brain functioning. This amino acid is available naturally through foods such as eggs, dairy products, meats, fish, beans, and some vegetables such as beets, cabbage, and spinach. It is also available in powder, tablet, or capsule form.</p> <p>NOTE- Anyone with kidney or liver disease, Reye's Syndrome, or cancer should avoid taking this supplement.</p>	<p>surgery.</p> <p>ATHLETIC USES- Athletes primarily use glutamine for faster recovery of overstressed or broken down muscle fibers during times of inadequate recovery between workouts. This usage also helps restore immune system functioning that is weakened by persistent trauma to the musculoskeletal system.</p>	<p>ATHLETIC USES- The dosages depend on the product used. Users should read all product labels and contact a physician prior to taking the first dose to figure out the correct starting dose. On average, most companies suggest taking between 2-15g per day by taking 5g post-workout and the remainder in divided doses. Some research has advocated taking 0.1g per kg of weight and taking the dose every 30 minutes for 2-3 hours. Depending on the user's weight, this could total between 30-40g post-workout.</p>	
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NOTE

Supplements are not required to be reviewed by any regulatory body and they do not have to be approved by the FDA before they are placed on the store shelves. Despite the FDA's recall of 71 prohormone drugs, the supplement manufacturers quickly created new products or brand names to get their products back in the market. All consumers should do their research on the companies that are distributing the supplements and the actual ingredients in the supplement to avoid injury. Additionally, not all of the above described supplements will result in all of the adverse side effects, but most individuals who use them will likely have at least some combination of the listed side effects.

Supplement info is available from the following sources:

1. National Institute on Drug Abuse at (www.gdcada.org)
2. National Council Against Health Fraud, Article "Thermogenic Products" by William T. Jarvis PH.D
3. Noble prize winners Robert F. Furchgott, Fend Murad, and Louis J. Ignarro MD for Nitric Oxide research from (www.nobleprize.org), (www.ehow.com), and (www.fitflex.com)
4. Harvard School of Public Health at (www.hsph.harvard.edu)
5. Journal of Nutrition at (www.jn.nutrition.org)
6. University of Maryland Medical Center at (www.umm.edu)
7. (www.mayoclinic.com) with evidence based research by Natural Standard Research Collaboration at (www.naturalstandard.com)
8. (www.sciencedirect.com)
9. (www.yourtotalhealth.ivillage.com)
10. For all supplement products to include each product's dosing recommendations, ingredients, and suggested usage, (www.bodybuilding.com) was referenced where each product's labels were verified.
11. TG295 The Warfighters Pocket Guide to Dietary Supplements and their suggested resources at (<http://chppm-www.apgea.army.mil>), (<http://www-nehc.med.navy.mil>), and (<http://www.navigator.tufts.edu>)

SUMMARY AND CONCLUSIONS

It is not possible to determine causality of injury or adverse effect from the information presented in this article. However, given the serious nature of several of the adverse effects seen by the authors, research should be conducted to determine the true effects and increase awareness of these substances. The fact that the FDA does not regulate dietary supplements is a major hindrance in investigating the true effects of each supplement and also in enforcing the composition and quality of supplements on the market. Unfortunately, despite the known risks, Soldiers will continue to use supplements. Many have used them successfully without apparent physical harm and others will likely attempt to replicate these results without doing proper research. The purpose of this article is to inform providers and Soldiers that some dietary supplement users may be experiencing significant injuries as a result of using these substances and to recommend that scientifically based research be done on dietary supplements to provide more information on dosing and adverse reactions. Medical professionals have a duty to educate their patients about the potentially adverse effects of supplements to prevent avoidable injuries. Similarly, individual Soldiers must exercise personal responsibility in seeking reliable sources of information about supplements before they use them.

CLINICAL RECOMMENDATIONS FOR PROVIDERS

1. Report possible supplement injuries to the FDA in accordance with MEDCOM policy.
2. Ask every patient about health supplement use in accordance with MEDCOM policy.
3. When treating these patients, ask the brand name, dosage taken, frequency taken, and where supplement information came from.

4. When questioned “off-line” about a supplement, dig further and educate the patient.
5. Educate the patient when possible.
6. When seeing an increased frequency of usage in a team, educate the team medic. Often the team medic will have far more rapport with the team members than a provider echelons above them will.
7. Visit the gyms frequently and get to know the members of the unit. Discuss health supplements “off line” with any Soldiers making unusually large or fast muscle gains.

DISCLAIMER

The authors do not endorse use of supplements nor any specific supplement brands named in this article. Additionally, some supplements listed in this article may become banned or recalled before this article is published.

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3. Lopez RM, Casa DJ, McDermott BP, Ganio MS, Armstrong LE, Maresh CM (2009) Does creatine supplementation hinder exercise heat tolerance or hydration status? A systematic review with meta analysis. *Journal of Athletic Training*. 44(2): 215-223.
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The Use of Fresh Whole Blood Transfusions by the SOF Medic for Hemostatic Resuscitation in the Austere Environment

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ABSTRACT

The leading cause of death on the battlefield is uncontrolled hemorrhage.^{1,2} Non-compressible (truncal) hemorrhage is the cause over two thirds of these deaths.³ This makes truncal hemorrhage the leading cause of potentially survivable death on the battlefield.⁴ Over one third of the casualties who arrive at the emergency department (ED) or combat surgical hospital (CSH) in need of a blood transfusion are already suffering from acute traumatic coagulopathy which is associated with an 80% mortality.⁵⁻¹¹ Early aggressive treatment and prevention of this coagulopathy through hemostatic resuscitation has been shown to increase survival.^{5,6,8,12,13} Hemostatic resuscitation involves the very early use of blood and blood products as primary resuscitation fluids to both treat intrinsic acute traumatic coagulopathy and prevent the development of dilutional coagulopathy. Few, if any, of the products used in hemostatic resuscitation are currently available to the Special Operations Forces (SOF) medic. Warm fresh whole blood transfusions could be a powerful tool for the SOF medic to use in order to begin hemostatic resuscitation in the field.

DISCLAIMER: The recommendations in this manuscript are only guidelines and are not a substitute for good clinical judgment. The views and opinions expressed in this manuscript are those of the authors and do not reflect the official policy or position of the Army Medical Department, Department of the Army, the Department of Defense, or the U.S. government.

Part of the current standard of care for hemostatic resuscitation is the use of component therapy (CT).¹³ CT involves targeted use of the various parts of blood, including red blood cells (RBCs), plasma, and platelets, that have been separated from a donated unit. A donated unit of blood is considered “whole blood” before it is separated into its components. The components are combined with anticoagulants and stored frozen or refrigerated prior to use in order to prolong their storage life. CT products need to be thawed and warmed prior to use in order to avoid causing or worsening hypothermia, which in turn inhibits clotting and has been shown to increase mortality.¹⁴⁻²⁶ The storage and administration considerations associated with most CT products make them too logistically burdensome for the SOF medic and therefore largely impractical for the SOF operational environment. At least one SOF unit has a protocol for the use of fresh frozen plasma to be carried freshly thawed by the SOF medic. To date this unit has not used FFP in the field or during TACEVAC due to logistical and tactical considerations.

Massive transfusion (MT) is generally defined as 10 or more units of blood in the first 24 hours after admission.²⁷ The most critically injured patients are the most likely to need a MT of blood.²⁸ The use of CT in MT has been shown to cause a myriad of complications that worsen the lethal triad of coagulopathy, acidosis, and hypothermia.²⁹⁻³⁶ The increased use of blood products is associated with increased mortality, presumably due to the more severely injured casualties needing more blood and blood products.^{37,38} This increase in mortality has been shown to be higher with blood products that have been stored longer.³⁸ The current clinical practice guideline (CPG) from the Joint Theater Trauma Registry (JTTR) and other authors recommend that CT products be used in a ratio identical to whole blood.³⁹⁻⁴² Several studies show improved outcomes using an equal or higher ratio of fresh frozen plasma (FFP): packed red blood cells (PRBC).^{3,9,40,43-55} One retrospective study found a 1:1.4 ratio of FFP to PRBCs to be independently associated with improved patient survival ($p < 0.001$) and also recommended a 1:1 ratio of FFP:PRBCs.⁶ WFWB has more

clotting factors than CT and none of the associated storage problems.

The use of warm fresh whole blood (WFWB) or “buddy transfusions” by the SOF medic is an appealing prospect. In contrast to use in civilian or military medical treatment facilities (MTFs), WFWB may be the only efficacious resuscitation method available

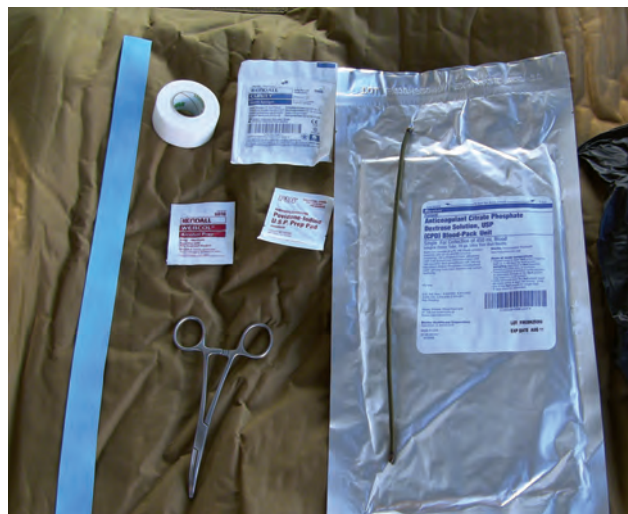


Figure 1: Equipment needed to perform collection of 1 unit of warm fresh whole blood. (Author's collection)



Figure 2: Equipment needed to perform infusion of whole blood. (Author's collection)

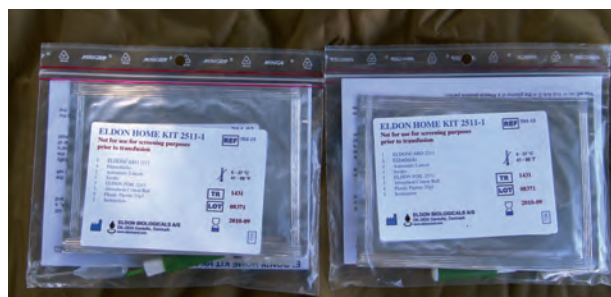


Figure 3: Blood typing cards. (Author's collection)



Figure 4: First line drugs to treat anaphylaxis. (Author's collection)

to combat coagulation disorders associated with hemorrhage.⁵⁶⁻⁵⁸ The amount of equipment needed for WFWB transfusion is relatively small (Figures 1-4), thus making it logistically feasible for the SOF medic. The only additional equipment not normally carried by the SOF medic are a blood collection bag, blood administration set, and blood typing cards. The advantages of WFWB over CT are many (Table 1).^{5,6,59}

While the use of a single unit of WFWB may only be roughly equivalent in volume to a single unit of CT, there are additional factors to consider. As shown in Table 1, WFWB does not need to be warmed, has a higher concentration of RBCs, more platelets, 100% of its original clotting factors, and double the fibrinogen.

Table 1 Side-by-Side Comparison of WFWB vs. Component Therapy. ^{5,6,59}							
	Constituents	Temperature	Hematocrit (% of RBCs)	Platelets	Coag factor %	Amount of fibrinogen	Amount of anticoagulant & additives
WFWB	500ml WFWB	37° C	38-50%	150,000-400,000	100%	1500mg	63ml
Component Therapy	680ml Total 1U PRBC + 1U PLT + 1U FFP + 1 U cry	-30° to 0°C	29%	80,000	65% (of initial)	750mg	205ml

(Adapted from Kauvar, Holcomb, Borgman, et.al.)

All of these aid in the effectiveness of clotting and the transport of oxygen. A unit of WFWB also has fewer anticoagulants, which only worsen the coagulopathic condition you are trying to correct. The use of fresh whole blood (FWB) has been shown clinically to improve the ability of the blood to clot, and even reverse dilutional coagulopathy and provide a hemostatic effect comparable to ten units of platelets.^{60, 61}

The Office of Medical History for the U.S. Army Medical Department (AMEDD) has an extensive history of the U.S. blood program entitled, *The Blood Program in WWII*. It contains over 100 statements, citations from studies, meeting minutes, memorandums, and the like that unequivocally endorse the use of whole blood as part of the comprehensive treatment for patients requiring life saving transfusions.⁶² These observations come from the years just prior to World War I through World War II and up to and including the Korean War. The fact that the use of FWB to treat hemorrhage in trauma patients is a controversial practice can only be attributed to a failure to study history or a significant misunderstanding of that history.⁶³⁻⁶⁵ At the beginning of WWII a system was in place to provide both FFP and the more stable freeze dried plasma (FDP). Whole blood was thought to be highly desirable and efficacious, but logistically impractical. Despite the considerable logistical problems involved, the armed services of the United States decided to implement an unparalleled program of collection, and distribution in all theaters of operation in order to bring whole blood as far forward as possible because it was considered so beneficial. Consider this passage from *The Blood Program in WWII: Supplemented by Experiences in the Korean War*, by Douglas B. Kendrick, Brigadier General, MC, USA (1963).

"The rather general belief at the outbreak of the war that plasma alone could compensate for the loss of whole blood in shock simply reflected the prevailing point of view that blood loss was not necessarily the primary cause of shock. It is not easy, in looking back, to understand how these concepts were ever accepted, yet some of the most competent physicians in the country believed that plasma alone could compensate for the massive blood losses which occurred in trauma. It was a belief which did a disservice to the true and important role of plasma in the therapy of shock. Also, as pointed out elsewhere, many observers who believed that only whole blood was effective in shock did not believe that it would ever be practical to provide it for forward areas.

Attempts to transfer controlled laboratory studies to combat conditions led to confusion, as might have been expected, for they were based upon faulty premises. As Beecher⁶⁶ pointed out, the belief that plasma would be as effective as whole blood in the management of hemorrhagic shock seems to have been derived from laboratory experiments so set up that the number of variables could be strictly limited. There was, of course, no real resemblance between a combat Soldier who had suffered

*a serious wound or wounds and a rabbit lying quietly in its cage after experimental deprivation of 75 percent of its blood volume. The very management of the wounded Soldier, including his successive removal rearward from the battlefield through the chain of evacuation, produced additional trauma, which was further increased by physical and roentgenologic examinations, anesthesia, and operation. Transfer of laboratory conclusions to a combat situation with its additional and widely different variables was simply unsound reasoning, which led to therapeutic confusion."*⁶²

Several authors in various civilian and military circumstances have recommended the use of FWB and WFWB and have shown to be superior in animal studies and of potential clinical benefit.^{13,59,61,65,68-78} During WWII, hundreds of thousands of units of whole blood were transfused in both battlefield and hospital environments and the rate of complications was comparable to those found in stateside civilian hospitals at the time.⁶²

FWB administered at far forward aid stations was credited with increasing the survival rate of wounded troops in Vietnam.⁷⁹ FWB was collected and used successfully in Mogadishu, Somalia, during the Battle of the Black Sea.⁵⁶ Over 6,000 units of FWB were transfused from March 2003 to July 2007 in Iraq and Afghanistan.⁶⁵ One retrospective study that looked at 500 patients receiving massive transfusions found that the 24-hour and 30-day survival were higher ($p=0.018$ and $p=0.002$ respectively) in a group receiving FWB versus a group receiving CT.⁷⁷ The risk of transfusion reactions did not appear to increase with the use of FWB in Iraq and Afghanistan.⁷⁷

The ability of the SOF medic to safely carry out the collection and administration of WFWB in an austere setting has been validated.⁸⁰ SOF personnel have used a training methodology at the Special Operations Combat Medic Skills Sustainment Course (SOCMSSC) since 2004, accounting for well over 105 practice sessions that involved collecting and reinfusing blood back into the same donor. The most common complication was an inability to use the collected blood because the bag was not full enough (approximately 15% incidence). A single case of suspected mild citrate toxicity was reported, presumably from an area of high citrate concentration within the bag that had not been fully mixed with the blood. It is thought that this area of high citrate concentration was infused into the patient when the bag was rolled in order to reinfuse the entire contents of the blood collection bag back into the patient. All of these errors can be eliminated with proper instruction and training in technique. WFWB transfusions were recently used by SOF personnel in North Africa to treat a seriously injured Soldier whose evacuation was delayed for several days.⁵⁷

The challenge is to outfit SOF medics with the proper equipment and training in order to allow them to use this hemostatic resuscitation tool safely and effec-

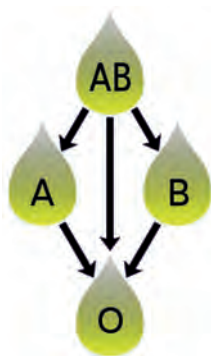


Figure 5: *Plasma Compatibility diagram*
(Wikipedia, GNU licensed)

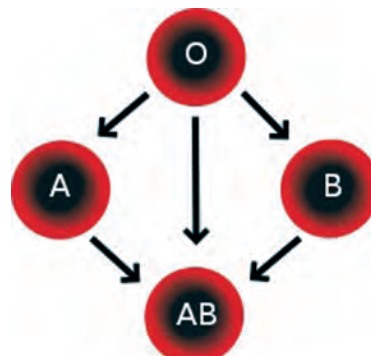


Figure 6: *RBC Compatibility diagram*
(Wikipedia, GNU licensed)

tively. The two major issues that must be addressed are the prevention of transfusion reactions and the transmission of bloodborne pathogens. The prevention of transfusion reactions is already addressed by the use of blood cards that can consistently provide an accurate blood type in less than ten minutes. The recently FDA approved ABORhCard® (Micronics, Inc., Redmond, WA) (Figure 7) can provide a low cost test the size of a credit card to accurately type blood in less than one minute.⁸¹ The risk of transfusion reactions can also be lessened by using the whole blood crossmatch test as described in The Emergency War Surgery Manual.⁸² Two separate efforts are currently underway to allow for rapid crossmatch testing in a small, lightweight test.^{81, 83} While neither the Eldon® nor the Micronics® blood typing cards are intended for prescreening prior to transfusion, current DoD guidelines and a NATO agreement provide for the use of ID cards and ID tags in order to transfuse whole blood during contingency operations.^{84, 85} The use of the blood typing cards is a safeguard to reduce the risk of a hemolytic reaction resulting from incorrect information from ID cards and ID tags (estimated to be incorrect 1.2 to 11% of the time).⁸⁶⁻⁸⁸ Several authors have recommended that stricter controls should be implemented during the production of ID cards and tags. It is also not entirely clear if the errors are attributable to self reporting or clerical errors, so cards and tags should only be produced using a laboratory test for reference. Another important aspect in reducing the risk of a crossmatch reaction is to educate medical providers about the erroneous notion of a “universal donor” for FWB.^{82, 89} The universal donor concept arose from the practice of calling PRBCs blood, when they are technically a blood component. While there is a universal donor for PRBCs, there is no universal donor for FWB.^{58, 90} Only type specific FWB must be given to avoid a hemolytic transfusion reaction (Figures 5 and 6).

In order to lessen the risk of viral transmission associated with FWB, rapid infectious disease screening tests are available that would not significantly in-

crease the overall weight and cube space of the SOF medic’s load. Retrospective testing of FWB unit screened with these tests revealed no false negatives, although the manufacturer only guarantees ranges between 98.2% and 99.4% among the various tests.⁹¹ Donors should all be retrospectively screened IAW the JTTR Clinical Practice Guideline for FWB transfusion which states:

“Retrospective testing for infectious disease markers will be performed on all donor specimens. This testing will be completed at an FDA-approved, DoD-sanctioned laboratory in accordance with FDA/AABB standards of medical care. Four EDTA and one red top tube will be collected for retrospective testing.”

There are currently efforts underway to develop a single, credit card sized test to rapidly rule out the presence of multiple bloodborne pathogens, which should make donor testing quicker and easier.⁸³

Several tactical and logistical factors that should be taken into account prior to deciding whether to perform a fresh whole blood transfusion in an aus-



Figure 7: *ABORh Card®*
(Courtesy Micronics, Inc.)
NSN 6550-01-585-7918 Unit
of Issue: Box of 12 Devices

tere environment. The decision making process that should be undertaken before initiating this procedure is well beyond the scope of this article. The need of the patient, availability of supplies and trained personnel, and the evacuation time must be weighed along with the tactical situation before considering this procedure. It is suffice to say that the decision to perform a fresh whole blood transfusion should be made only after considering all of the possible consequences and weighing them against the benefit of the patient. Chief among these considerations should be the possible catastrophic results to the patient should a hemolytic reaction occur and the degradation to the performance of the donor. At no time should more than one unit of blood be collected from a single donor and the donor should be given 500ml of Hextend or similar fluid following donation.⁶⁵ Optimally the donor should also be in a position to perform light duty for at least 72 hours following donation. Current Army regulations mandate that aircrew personnel are restricted from performing flying duties for this same period of time following whole blood donation.⁹² At no time should evacuation to a higher level of medical care, especially surgical care, be delayed in order to perform a buddy transfusion, but the procedure could conceivably be carried out during TACEVAC in under 30 minutes, depending on the medic's level of proficiency and experience with the procedure.

The clinical considerations involved in the decision to perform a fresh whole blood transfusion are beyond the scope of this article. Presumably the use of WFWB would be considered for uncontrolled truncal hemorrhage. Whether hypotensive resuscitation should be initiated with other fluids prior to considering WFWB transfusion would be an interesting debate, as would the use of other hemostatic resuscitative products. Interestingly, several MT protocols are being evaluated that could conceivably be adapted for use by the SOF medic in order to have a comprehensive resuscitation strategy that incorporates hypotensive and hemostatic resuscitation.⁹⁴⁻¹⁰⁰

The strategy of hemostatic resuscitation has addressed a critical need for patients presenting to EDs and CSHs. However, there are few, if any, tools for the SOF medic to begin any form of hemostatic resuscitation prior to arrival at an MTF. Under the right circumstances, and with the implementation of proper training and safety measures, WFWB transfusions can be that tool.



Whole blood packed in a marmite container on ice for use in the European Theater of Operations. (ETO) WWII. (U.S. AMEDD Office of Medical History)



Shipment of whole blood collected from rear echelon troops in the ETO, December 1944. (U.S. AMEDD Office of Medical History)



Blood in refrigerated marmite cans being unloaded from C-47 on grass landing strip by Soldiers of Blood Depot in France summer 1944. (U.S. AMEDD Office of Medical History)



*Whole blood dropped in a test parachute drop box on Guam. Box was later used by the Navy during the airlift in the Pacific and during the Korean War.
(U.S. AMEDD Office of Medical History)*



Medics administer plasma to wounded Soldier, Utah Beach, June 6th, 1944. (National Archives)



*Whole blood loaded aboard a helicopter for transport. Korea, June 1953.
(U.S. AMEDD Office of Medical History)*



*Navy Corpsman administers plasma to wounded Marine, Marshall Islands.
(Department of Defense, USMC)*



*Whole blood is administered to an airborne casualty, enclosed in metal capsule of a helicopter in Korea. Medical technician holds bottle over the wounded man during the 45-minute flight from the front lines.
(National Archives)*



Casualty receives whole blood at forward aid station on Iwo Jima. (Department of Defense, USMC)



*Soldier receives plasma at forward aid station in Korea.
(National Archives)*



Soldier arrives from 173rd Airborne Brigade frontline aid station with whole blood being pressure infused through an IV line. (Courtesy LTC (Ret.) William C. Gilcrease, 7th MASH, Cu Chi, Vietnam, 1966)



*Wounded Soldier receives whole blood near Ujong, Korea, April 1951.
(U.S. AMEDD Office of Medical History)*



Special Forces medic SSG Bill Scruggs administers IV fluids to wounded team leader CPT Stan Dubiel during battle to retake recently overrun firebase. Ha Than, Vietnam, August 1968. (Associated Press)



*Wounded Soldier receives whole blood aboard pod of MEDEVAC helicopter in Korea, October 1953.
(U.S. AMEDD Office of Medical History)*



Special Forces medic collects warm fresh whole blood during a field training exercise. (Author's collection)



Special Forces medic prepares to reinfuse recently collected warm fresh whole blood collected during a field training exercise. (Author's collection)



Blood at an undisclosed location in Southwest Asia. (Department of Defense, USAF)

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Management of Urinary Retention in an Austere Environment: Suprapubic Catheter Placement

**LTC Christopher P. Smith, MD; SFC Andrew Sorrells, 18D;
Michael Coburn, MD**

ABSTRACT

Urinary retention is a true urologic emergency. First-line treatment with a transurethral catheter can and will fail. Special Operations Forces (SOF) medics need a reliable and durable method to resolve this problem using a minimal amount of resources and time. Current SOF Medical Handbook guidance for the management of unsuccessful urethral catheterization is inadequate. This article and accompanying video link, function as a starting point for incorporating suprapubic tube placement in the training regimen and therapeutic armamentarium of SOF medical personnel.

CASE SCENARIO #1

You are a SOF medic assigned to a remote area in Africa. A Soldier is brought to you after a rollover motor vehicle accident (MVA). He has an obvious pelvic fracture and on physical exam is found to have blood at the urethral meatus. On digital rectal exam his prostate is not palpable. You suspect a posterior urethral injury. A gentle pass with a transurethral catheter is unsuccessful – resistance is encountered and blood returns through the catheter, so no further advancement is attempted. The patient's suprapubic area is distended and he complains of an unbearable urge to urinate. How do you manage this Soldier's urinary retention?

CASE SCENARIO #2

You are a SOF medic assigned to a remote fire-base in Afghanistan. A prominent and influential tribal chief is brought into your clinic complaining of an inability to urinate. He gives a long history of urethral stricture disease treated in the past with rudimentary urethral dilations. On physical exam, he has a palpable mass to the level of the umbilicus that is dull to percussion and he describes a strong and painful urge to void when pressure is applied. You are unsuccessful in your attempts to pass a transurethral catheter. You do not have the ability or resources to perform urethral dilation. Aerial evacuation assets are not available. What do you do next?

INTRODUCTION

Urinary retention is a true urological emergency. Failure to drain the bladder is not only painful for the patient but can lead to significant comorbidities (i.e.,

urosepsis, uremia, or, rarely, intraperitoneal bladder rupture and subsequent peritonitis). Drainage of urine is also vital to monitoring urine output in a critically ill patient and also to confirm adequate fluid resuscitation. First-line treatment of urinary retention is transurethral placement of a self-retaining Foley balloon catheter. However, transurethral catheterization is either contraindicated or may not be possible under certain conditions. SOF medics need a reliable and durable method to resolve this problem using a minimal amount of resources and time.

Current SOF Medical Handbook guidance for the management of unsuccessful urethral catheterization is inadequate.¹ On the one hand, it describes suprapubic bladder aspiration using a long spinal needle. While this method is a useful one-time treatment, repeated attempts to manage a casualty in this manner over time risk inadequate bladder drainage, troublesome hematuria, or injury to adjacent organs (i.e., bowel, blood vessels) and interfere with a medic's ability to manage other casualties.

Suprapubic catheter placement allows for continuous and, when necessary, long-term bladder drainage and monitoring of fluid output following a single procedure. The current SOF medical handbook chapter provides only scant details on suprapubic tube placement: "For suprapubic catheter placement, follow instructions on the specific catheter package insert. Do not attempt suprapubic catheter placement if you have not previously been instructed in the technique as misplacement can result in serious bowel or vascular injury."² These cautionary notes are well-founded, but with appropriate training and in properly selected patients, the SOF medic can safely perform this procedure with low risk. This article and ac-

companying video link describe in detail the indications for and technique of suprapubic tube placement.

Table 1. Common Indications for Suprapubic Catheter Placement
Urethral Injury
Urethral Obstruction
Bladder Neck Mass
Benign Prostatic Hyperplasia
Prostate Cancer

INDICATIONS

Urethral trauma is anatomically divided into posterior urethral and anterior urethral components. Posterior urethral trauma is usually associated with pelvic fractures and multi-system trauma (for example resulting from a MVA or fall) (Figures 1 & 2). Up to 10% of males and 6% of females with pelvic fractures also suffer from a posterior urethral injury.³ The typical presenting triad includes blood at the meatus, urinary retention, and a palpably full bladder (Figure 3). Anterior urethral trauma is usually an isolated injury commonly found after a straddle accident involving blunt trauma to the bulbar urethra. A minority of anterior urethral injuries result from direct trauma to the penis or scrotum (Figure 4). Penetrating injuries to the genitalia or perineum or blast injuries with contusion, laceration, or shrapnel entry may also result in urethral injury.

Urethral trauma can occur during transurethral catheter placement. Traumatic catheterization usually results from either balloon inflation within the bulbar or prostatic urethra or false passage creation during Foley

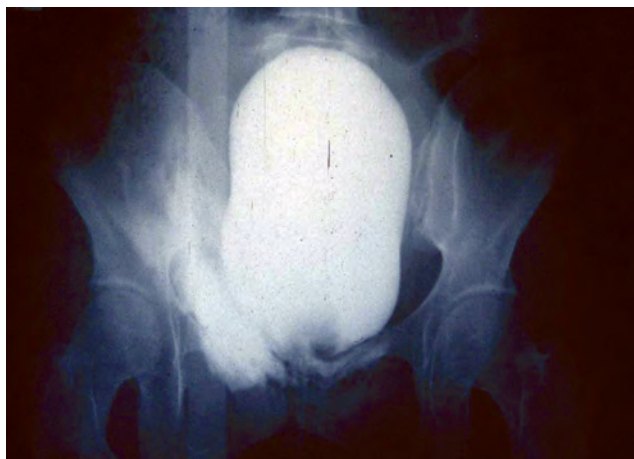


Figure 1: Stress cystogram with extraperitoneal bladder rupture in a patient with pelvic fracture; extravasation noted on right side. Patient with a head injury, distended bladder, and unable to void. A urethral catheter would be first choice. However, if this injury was accompanied by a posterior urethral distraction injury, a suprapubic tube would be the preferred management.



Figure 2: Extensive extravasation on retrograde urethrogram after pelvic fracture and posterior urethral distraction injury. Contrast is noted in soft tissue both above and below the urogenital diaphragm, demonstrating the extent of pelvic floor injury. Note the “pie in the sky” bladder – a percutaneous suprapubic tube was placed under ultrasound guidance.



Figure 3: Blood at the urethral meatus, a typical finding after pelvic fracture with posterior urethral distraction injury. A percutaneous suprapubic tube was placed in the emergency center for urinary retention and planned delayed realignment.



Figure 4: Severe external genital injury – penile laceration. A suprapubic tube was placed preoperatively while awaiting surgery (urethra was transected, and the patient was in urinary retention with a palpably distended bladder).

insertion. Men with known prostate enlargement, or those in whom significant resistance is encountered on a straight Foley placement attempt, should be catheterized with a curved tip or coudé catheter, with the curved tip facing towards the patients head during insertion. While urethral trauma resulting in the inability to catheterize the urethra is uncommon in women, pelvic fracture or direct perineal trauma may injure the female urethra and require suprapubic tube insertion. The presence of blood on vaginal exam or an obvious vaginal or perineal laceration, especially in the setting of a suspected pelvic fracture, should raise suspicion of a female urethral injury, and should be addressed through the same treatment algorithm as for men.

Urethral strictures are another possible indication for suprapubic catheter placement. They commonly are associated with prior urethral trauma, but also can be the result of inflammatory urethritis induced by gonorrheal infection or lichen sclerosis–balanitis xerotica obliterans (LS-BXO) disease. In addition, prior lower urinary tract surgical procedures (i.e., transurethral resection of the prostate [TURP], radical prostatectomy) can also induce urethral scar formation. Finally, locally advanced prostate cancer may produce obstruction causing difficulty with urethral catheterization.

CONTRAINDICATIONS

Suprapubic catheters should not be placed in individuals in whom the bladder is not readily palpated or percussed during physical exam or clearly identified as distended based on ultrasound examination, if available. It should also be aborted if urine is not easily aspirated using a narrow finder needle (i.e., spinal needle). This procedure should not be performed in patients with coagulation disorders; caution should be exercised in patients with evidence of prior lower abdominal surgery or pelvic radiation treatment as this may increase the risk of adherence of adjacent organs (such as bowel) to the bladder or pubis with resultant injury.

TYPES OF INTRODUCERS

There are different model types of suprapubic catheters available on the market. Some introducers use a catheter that is passed over a metal trocar. In the author's personal experiences, it can sometimes be difficult to disengage and pass the catheter over the trocar and into the bladder. A second model type is one in which the catheter is passed through a sheath after the bladder is punctured by a trocar/sheath combination. Some catheters have self-retaining features (i.e., inflatable balloon or mallecot tip) while others require a suture to fix in place. Important factors to consider using one of these models is the size of the drainage tube the sheath can accommodate as smaller tubes can frequently kink or obstruct. Also, any system that minimizes the procedure complexity and packaging requirements would be

Lawrence Add-a-Cath Suprapubic Catheter Introducer

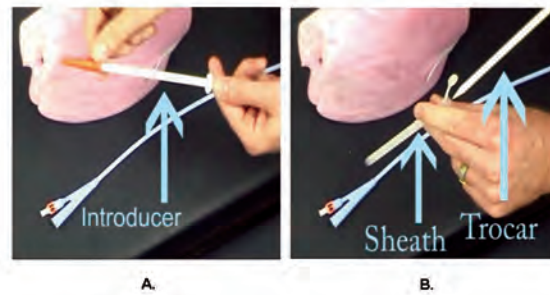


Figure 5: A: The Lawrence Add-a-Cath® Suprapubic Catheter Introducer incorporates a stainless steel point (beneath orange cap) that allows for controlled penetration using a gentle twisting motion with minimal trauma to surrounding tissues. B: The introducer contains an inner trocar connected to an outer sheath via a tab on the sheath that “locks” with the handle of the trocar. Once the introducer is placed within the bladder, the tab is pulled back to disengage the trocar from the sheath.

advantageous to the SOF medic. The Lawrence Add-a-Cath® Suprapubic Catheter Introducer (Femcare-Nikomed Limited, UK) allows for placement of a self-retaining Foley catheter up to 16 Fr in size with a simple device that is small and lightweight (Figure 5).

SUPRAPUBIC CATHETER PLACEMENT PROCEDURE (LAWRENCE ADD-A-CATH®)

A video recording of the suprapubic procedure can be viewed using the following link: (<http://www.socom.mil/JSOM/Pages/default.aspx>).

Four steps should occur before placement of the suprapubic introducer. First, prepare the abdomen with an antiseptic solution. Second, mark a point two fingerbreadths superior to the pubic bone in the midline (Figure 6). Third, inject a local anesthetic through the marked point targeting the skin and the rectus fascia, with the injection extending into the soft tissues near the bladder. Finally, using the same syringe, “tap” the bladder by inserting the needle below the rectus fascia until urine is aspirated. This will confirm that the bladder is indeed full and will also provide information on the depth of insertion required to enter the bladder. Ultrasound, if available, can be an aid in diagnosing bladder retention as well as in guiding needle and introducer placement.

Using a scalpel or blade, make a small incision in the previously anesthetized skin. Insert the introducer using a twisting motion as pressure is applied, orienting the introducer directly posterior. One should feel a “pop” or give as the rectus fascia is punctured. Continue to apply the same steady twisting pressure



Figure 6: The insertion site for suprapubic tube placement is in the mid-line, two fingerbreadths above the pubic bone.

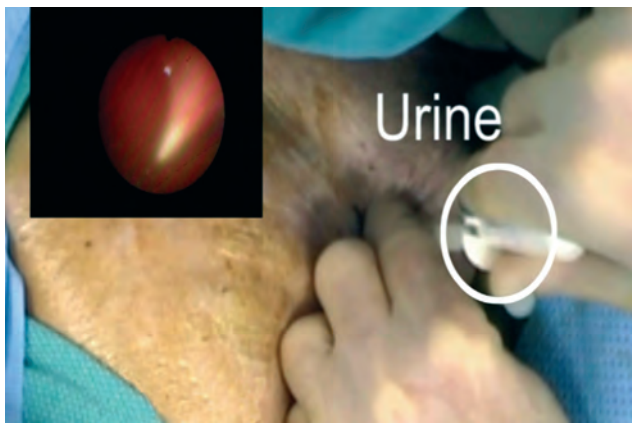


Figure 7: After the rectus fascia is pierced (“pop”), the introducer is passed several centimeters posterior until the bladder lumen is entered and urine can be visualized exiting the groove between the trocar and sheath. Note the inset photo demonstrating view from inside the bladder (cystoscopic view) as the introducer tip punctures the bladder wall.

and insert the introducer further until urine can be seen travelling up the groove in the sheath (Figure 7). With a very controlled motion, insert the introducer 3-4cm further so that sheath will be completely within the bladder. Take care not to pass the sharp introducer beyond the bladder lumen and into or through the posterior bladder wall. Flip the tab unlocking the trocar from the sheath. Now remove the trocar, a large amount of urine should drain from the sheath (Figure 8). Place a Foley catheter through the sheath and into the bladder. Inflate the balloon with 10ml of sterile water or normal saline taking care not to introduce any foreign material into the balloon lumen (which can cause difficult balloon deflation). Withdraw the sheath from the patient’s abdomen as the tab is peeled down-

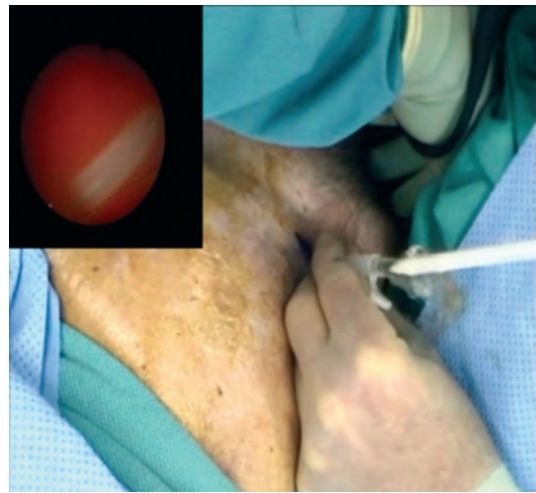


Figure 8: As the trocar is removed from the sheath, a large amount of urine should drain, confirming proper placement of the introducer within the bladder (see inset photo of cystoscopic view from within the bladder demonstrating sheath adequately placed through dome of bladder). A Foley catheter should be placed through the sheath and the balloon inflated with 10 ml of sterile water (preferable).

ward. Remove the sheath from the Foley catheter and gently withdraw the catheter.

The catheter may be withdrawn until the balloon is located against the bladder wall, or some portion of the catheter shaft may safely remain within the bladder. In some pelvic fracture cases, an enlarging retropubic/prevesical hematoma can cause the bladder to pull further away from the anterior abdominal wall, resulting in migration of the catheter out of the bladder; in such cases, it is safer to not withdraw the catheter fully to the anterior bladder wall upon insertion. A suture, if available, can be used to help further secure the suprapubic catheter at the skin entry site (i.e., a moderate-sized bite of skin is included in the stitch that is then tied down; the strands are then wrapped around the catheter, snugged down and tied to secure it (i.e., sandal wrap), taking care not to tie it so tight as to occlude drainage.

COMPLICATIONS

Complications include gross hematuria; generally this is self-limited if related to introducer placement and can be managed with saline irrigation of the catheter as needed. Occasionally, troublesome hematuria with clot formation may occur after suprapubic tube placement, potentially due to pre-existing concomitant bladder injury. Again, periodic irrigation with normal saline may be necessary. The risk of clotting is mitigated by placement of a larger caliber suprapubic tube. Injury to bowel or pelvic vasculature can be prevented or minimized by avoiding suprapubic catheter placement in those at risk of bowel/vessel ad-

herence (e.g., prior pelvic surgery/radiotherapy), using a small caliber spinal needle +/- ultrasound (if available) to localize and confirm bladder distension before passing the larger suprapubic introducer, and using caution not to pass the introducer through the posterior bladder wall. Post-obstructive diuresis can occur, particularly in cases of prolonged retention and azotemia (i.e., elevated serum blood urea nitrogen). Treatment begins with self-hydration for thirst but can require intravenous fluid administration and electrolyte monitoring and replacement in extreme cases.

DISPOSITION

Once a suprapubic tube is placed, the patient should be evacuated to higher level medical care at the earliest opportunity for treatment of his/her underlying urologic condition. If higher level medical treatment is not available (e.g., in remote area or the patient is part of the indigenous population), then the initial catheter change should occur four weeks after placement (i.e., to allow the tube tract to mature) by a healthcare provider. Subsequent tube changes should occur every three to four weeks (i.e., family members can now be instructed on tube change procedure) to prevent infection and tube occlusion or encrustation.

The suprapubic catheter should only be discontinued after the underlying medical condition is treated or, alternatively, if transurethral access is obtained. Under these circumstances, the suprapubic catheter can be discontinued by removing the stitch if present, deflating the catheter balloon, and removing the catheter. The suprapubic wound should be left open for secondary closure and managed with sterile gauze dressings. The bladder opening will usually seal off within several hours of tube removal although the skin wound may take a couple weeks to completely heal. Finally, although

not ideal, urinary retention can be managed with suprapubic tube drainage on a long-term or permanent basis as long as the catheter is changed with regularity (i.e., every three to four weeks).

CONCLUSION

SOF medics operating in austere environments need the skills, resources, and equipment to effectively manage urinary retention that cannot be treated by transurethral catheterization. This article and accompanying video link functions as a starting point for incorporating suprapubic tube placement in the training regimen and therapeutic armamentarium of SOF medical personnel. SOF medics can gain further exposure and experience with the various suprapubic tube kits and placement techniques by observing such procedures in the military or civilian urological office, emergency center, trauma center, or hospital procedure setting. Specific questions can be addressed by contacting Doc Smith at:

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Zoonotic and Infectious Disease Surveillance in Central America: Honduran Feral Cats Positive for Toxoplasma, Trypanosoma, Leishmania, Rickettsia, and Lyme Disease

MAJ Michael McCown, DVM; SFC Benjamin Grzeszak, 18D

ABSTRACT

A recent zoonotic and infectious disease field surveillance study in Honduras resulted in the discovery of Toxoplasma, Trypanosoma, Leishmania, Rickettsia, and Lyme disease with significantly high prevalence rates in a group of feral cats. All five diseases – toxoplasmosis, trypanosomiasis, leishmaniasis, rickettsiosis, and Lyme disease – were confirmed in this group of cats which maintained close contact to local civilians and U.S. personnel. These diseases are infectious to other animals and humans primarily through vector transmission or ingestion. In the austere Central and South American sites that Special Operations Forces (SOF) medics are deployed, the living conditions and close quarters are prime environments for the potential spread of infectious and zoonotic disease. This study's findings, as with previous veterinary disease surveillance studies, emphasize the critical need for continual and aggressive surveillance for zoonotic and infectious disease presence within animals in specific areas of operation (AO). The importance to SOF is that a variety of animals may be sentinels, hosts, or direct transmitters of disease to civilians and servicemembers. These studies are value-added tools to the U.S. military, specifically to a deploying or already deployed unit. The SOF medic must ensure that this value-added tool is utilized and that findings are applied to assure Special Forces Operational Detachment - Alpha (SFOD-A) health and, on a bigger scale, U.S. military force health protection and local civilian health.

INTRODUCTION

Deployment Health Surveillance (DHS) continues to be crucial to current and future military operations in order to protect U.S. servicemembers from disease, occupational, and environmental hazards.¹⁻³ The veterinary application to the DHS and the SOF medic's integrated and integral role was previously described in this *Journal*.⁴ These studies and articles specifically call upon the SOF medic to apply two U.S. Army veterinary public health mission priorities – zoonotic and infectious disease surveillance and food/water safety – to enhance mission success by protecting force health.

During recent deployments to Central America, zoonotic and infectious disease field surveillance studies were performed. A group of animals in contact with a specific segment of local population and U.S. troops was selected and blood tested. The goal of this study is to enhance mission success in Honduras and other Central American AOs by enhancing force health

protection. Disease surveillance findings increase mission planners' health knowledge for specific AOs and medical planning for select missions. This will assure force health protection and the force's ability to accomplish the mission. The politically and culturally sensitive Humanitarian/Civil Assistance (HCA) SOF missions will be enhanced by integrating disease surveillance into SOF operational planning.

This article's intent is to provide the SOF medic and SOF community the findings of zoonotic and infectious disease surveillance study in a Central American AO. Past SOF surveillance studies' findings of *canine ehrlichiosis*⁵ and *equine infectious anemia*⁶ in South American military working dogs and horses, respectively, should be referenced. These types of surveillance studies give a clearer picture of endemic or emerging disease and the medical risk of disease to U.S. personnel and the local civilian populations. This disease surveillance study was designed to determine dis-

ease prevalence rates and risk to US forces operating in the area. Data, if obtained, is usually incomplete or outdated from these types of rural regions.

DISEASE SURVEILLANCE RESULTS

The following disease surveillance study results are from an actual SOF AO in Honduras. The animal study group selected was feral/stray cats in the vicinity that had contact with U.S. personnel and local civilians. Further, this group of cats lived in an enclosed, fenced community limiting movement in or out. It was determined that the group consisted of 50 cats of varying ages. Some cats (an estimated 20%) were friendly enough to be held, fed, and housed. A representative sample of 12 cats, or 24%, out of the 50 cats were sampled. Cats were safely trapped by trained veterinary personnel. The cats were examined for outward signs of disease, and ectoparasites were collected for identification. Blood samples were obtained and an IDEXX SNAP® Feline Triple® Test⁷ was used on-site to test for Feline Immunodeficiency Virus (FIV), Feline Leukemia Virus (FeLV), and Feline Heartworm (FHW) disease.

None of the cats tested positive for FIV, FeLV, or FHW disease. More specific laboratory testing (IFA screen at 1:32 and 1:64) of the remaining blood samples confirmed the presence of *Toxoplasma gondii*, *Leishmania donovani*, *Trypanosoma cruzi*, *Rickettsia rickettsii*, and *Borrelia* species (Lyme disease).

The prevalence rates of disease in the representative sample group of 12 cats (from the 50 cat group) were as follows:

- *Toxoplasma gondii* 33% prevalence rate (4 positive out of 12 cats)
- *Leishmania donovani* 25% prevalence rate (3/12)
- *Trypanosoma cruzi* 16% prevalence rate (2/12)
- *Rickettsia rickettsii* 16% prevalence rate (2/12)
- Lyme disease 25% prevalence rate (3/12)

DISCUSSION

In the current austere Central and South American areas that SOF medics are deployed, the living conditions and close quarters set a prime environment for the spread of a variety of diseases, including these zoonotic diseases. The initial signs and symptoms of some of these zoonotic diseases can be similar to the usual symptoms of a sick teammate. These symptoms include headache, general malaise, diarrhea, dermatitis (i.e., rash), nausea, fever and vomiting, all of which a SOF medic commonly blame on the local water supply or food preparation. Given the results of the study, the SOF medic must see the value of disease surveillance testing in animals. The SOF medic can examine,

evaluate, and test the domestic animals near the detachment's living quarters at the beginning of the deployment to get an estimate on possible ectoparasites or zoonotic infectious diseases in the area. This information will give the SOF medic a hand in developing a differential diagnoses for future treatments of teammates while deployed, especially in remote areas where sending blood off to be cultured or tested is a complicated endeavor.

The parasitic protozoon, *toxoplasma gondii*, is the causative agent for toxoplasmosis. The SOF medic should be aware that Toxoplasmosis is implicated in causing fetal death in pregnant women and serious effects to an immunocompromised person.

T. gondii tissue cysts are ingested by a cat, the definitive host, when feeding on infected small animals such as rodents. *T. gondii* oocysts are then shed in the cat's feces. Other animals and humans may become infected after ingesting these oocysts.⁸ This may occur when eating improperly washed fruits/vegetables, when eating improperly cooked meats, or in cases of poor hygiene. Pregnant women should be advised not to clean cat litter boxes due to the potential for fecal-oral transmission. The SOF medic has the opportunity to educate U.S. personnel as well as a local civilian community on improving personal hygiene (proper hand washing) and prevention of this disease.

Trypanosoma cruzi is the parasitic causative agent for trypanosomiasis diseases in humans and animals. The Reduviidae bug vector deposits feces on the skin of an animal or human and then bites. The host then scratches the superficial bite area allowing penetration of the infected feces.⁹ The SOF medic must be aware that human American trypanosomiasis, also known as Chagas disease, is a very prevalent disease in Central and South American and is known to have fatal consequences.

The protozoon, *leishmania donovani*, is the causative parasite for leishmaniasis. Spread through the cutaneous bites of sand flies, the three types of leishmaniasis are cutaneous, mucocutaneous, and visceral leishmaniasis.¹⁰

Rickettsia rickettsii is the bacterium responsible for Rocky Mountain spotted fever. This bacterium is passed to humans and animals through the bites of *Dermacentor* species ticks, serving as both reservoirs and vectors.¹¹

Borrelia burgdorferi is the causative bacterium responsible for Lyme disease, passed through the bite of the *Ixodes* species tick (deer tick), the primary tick vector.¹²

Along with animal blood testing, concurrent ectoparasite surveillance, sampling, and identification provide useful information to mission and medical planners. The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Tick Test Kits are now available [USACHPPM is now the U.S.

Army Public Health Command (Provisional)]. These kits provide sampling containers and shipping materials for ectoparasite field surveillance (see photo). The ectoparasite samples, such as ticks and fleas, are sent to USACHPPM [USAPHC (Prov)] to be identified and tested for disease organisms they may be carrying. Such diseases caused by ectoparasites include *Bartonella* (bartonellosis), *Borrelia* (Lyme disease), *Babesia*, *Dirofilaria* (heartworm disease), *Ehrlichia* (ehrlichiosis), and *Anaplasma* (anaplasmosis). To order test kits, call 410-436-3616 DSN 584.

CONCLUSION

The findings of this research confirm the presence of infectious and zoonotic diseases in a Central American SOF AO. The five diseases all have different vectors or means to infect humans and animals. Therefore, SOF medics must assure comprehensive preventive measures for all U.S. personnel operating in these areas, as well as educating local civilian communities.

The goal of this article is to increase the SOF medic's knowledge and awareness of zoonotic and infectious disease threats through surveillance studies in animals. Additionally, the USACHPPM [USAPHC (Prov)] Tick Test Kit ectoparasite field surveillance tool was identified for the SOF medic's use. These findings emphasize the critical need for continual and aggressive field surveillance for zoonotic and infectious disease presence within animals. These diseases have the capability of significantly impacting mission accomplishment by affecting force health. Without question, the surveillance studies are value-added tools to the U.S. military, specifically to a deploying or already deployed conventional or SOF unit. The SOF medic must ensure this capability is planned for, used, and directly applied to assure SFOD-A health and mission.

Note: The authors included the IDEXX SNAP® test kits as an example for the 18D, but do not endorse this product.

The authors extend a very special thanks to Mr. Ed Cooper for his invaluable laboratory testing and expertise.



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Dr. McCown is an UF CVM graduate and had the distinct honor and privilege to work with SOF medics and other SOF NCOs while serving on active duty with SOF thru 2005.

SFC Benjamin Grzeszak is a Special Forces Medical Sergeant currently assigned to 7th SFG(A). He has served three combat tours with 7th SFG(A) in Afghanistan in support of the Global War on Terrorism and two deployments to South America.

Hurlburt Dental Team Aids, Trains West African Countries

SrA Ryan Whitney
1st Special Operations Wing Public Affairs
6/16/2010 - HURLBURT FIELD, FL

Two Hurlburt dental Airmen recently returned to work after a one-month temporary duty assignment to West Africa in support of Exercise Flintlock, an annual exercise that focuses on improving interoperability between the military forces of the United States, Europe, and Northern and Western African countries.

Capt Tad Tholstrom and SSgt Leah Potter, 1st Special Operations Medical Group dentist and a dental technician, participated in the 20-day exercise that began 3 May 2010. While there, they provided dental treatment to the African citizens of Senegal and Burkina Faso, while also training and educating local and military dentists from the African countries.

“The people we were supporting were in severely underdeveloped areas; people that were living in mud huts and didn’t have a lot of medical options,” SSgt Potter said. “Though we accomplished a lot while we were there, there is always that feeling that there is more you could do or more you could have done while you were there.”

Past Medical Civic Action Programs like these have shown that dental service provides one of the biggest and longest-term impacts on health and welfare, alongside optometry and veterinary services. “Dental is special in the form of treatment because, for the most part, we are able to provide our patients with near-immediate relief. If a person comes to us with an abscessed tooth, we can provide on-the-spot treatment and they won’t have to worry about that pain anymore, as opposed to something that requires long term treatment when the doctor will only be around for a few weeks,” said Capt Tholstrom. “There is always another patient waiting and you always feel like you could do more so it’s pretty overwhelming, but it was very rewarding to help as many people as we did and put our training to use to help those less fortunate.”

Although they worked in austere conditions with the supplies they brought with them and a seemingly endless line of patients, one of the biggest challenges the dental team faced was simply communicating with their patients. Even though they had a translator to decipher the French-speaking citi-



Capt Tad Tholstrom (far left) and SSgt Leah Potter (far right), 1st Special Operations Medical Group dentist and dental technician, operate alongside a local dentist while treating a patient in West Africa. (courtesy photo)

zens’ words, every town they went to spoke a different dialect, sometimes requiring two or three different translators to effectively communicate.

“Once you learned some of the key phrases and dialects for common sayings, you were able to build up that relationship and trust with them to be able to communicate with them, even if it is just a few sayings,” said Capt Tholstrom.

Many of the patients were treated for the usual toothaches, abscessed teeth, and infections. One case, however, stood out in both the medical professionals’ minds as it involved a small child with a large tooth abscess that had expanded and was starting to obstruct his airway.

“This was one of the most severe cases I had seen, and if we hadn’t helped this child, he probably wouldn’t have survived,” Sergeant Potter said. “For

someone in the dental field, it's rare to say you've been able to save someone's life."

After treating patients and training and working with dentists in Senegal, the team then joined up with another Air Force Special Operations Command dental team from the 27th Special Operations Wing, and traveled to the country of Burkina Faso to discuss different treatment philosophies and procedures, and to train and provide support to local military dental teams.

"The experience we had of helping so many less-fortunate people and improving their quality of life was an amazing experience," Capt Tholstrom said. "My only regret was I didn't get to help more people, but I hope to be able to go back in the future to continue what I started."

These two Air Force dental teams fulfilled the first tasking from a newly stood-up AFSOC Surgeon General initiative, the Irregular Warfare Healthcare Engagement Division.

The Division was established to develop and implement an overarching healthcare engagement strategy in which AFSOC medical forces will be used to support the Department of Defense's Irregular Warfare and Stability Operations. These medical forces, as exemplified by the dental teams, are organized, trained, and equipped to provide medical support to combatant commanders with an emphasis on long-term, medical and healthcare capacity building efforts, efforts in which the Hurlburt dental team participated and contributed to first hand.



Case Review

A Case of Tapeworm Infestation

SSG Jared Kacoroski, SOCM; SPC Cody Bonk, SOCM; MAJ Scott Gilpatrick, APA-C, DMO

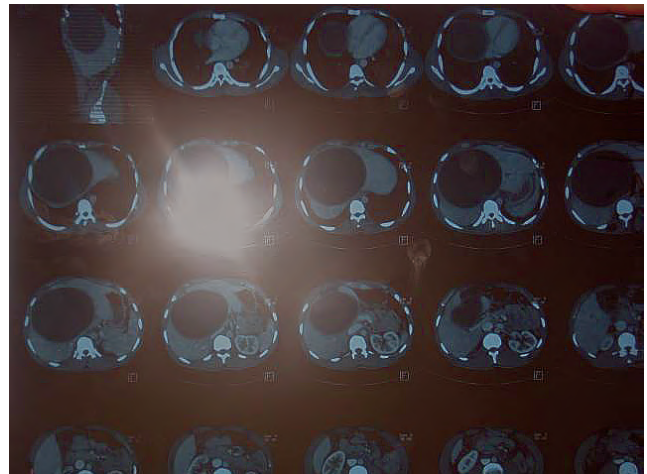
A 24-year-old male Afghan National Army (ANA) soldier in training presented to sick call complaining of several weeks of worsening, dull, and diffuse abdominal pain with abdominal distention with two days of constipation. He is from Kabul and resides full time at the Ranger camp. He visits his family regularly in the city and had no recent significant travel history. An extensive review of systems failed to disclose any additional symptoms and he was able to perform training with the rest of his unit.

His vital signs were normal and the physical exam was only notable for some central upper abdominal distention with diffuse mild tenderness. He was given a laxative and told to increase his fluid intake in hopes of relieving what was thought to be a case of constipation.

Several days later he returned and stated his constipation had somewhat resolved, yet he still had some distention and discomfort. He was taken to a local Afghan National Army (ANA) clinic and had an abdominal X-ray series performed that indicated retained stool still in his transverse colon. He was given Metamucil and told to return the next day. Several weeks later he returned to the clinic on sick call with an abdominal ultrasound report. He had reported to a local hospital while visiting his family with the same worsening complaints from his initial visits. The ultrasound was performed and no treatment was given.

The ultrasound report, translated to English, was notable for a 20cm hydatid cyst displacing almost the entire body of his liver. The remainder of the study was unremarkable. His physical examination that day was notable only for a palpably enlarged liver. The camp clinic is located in a relatively austere location which requires dangerous travel to larger facilities for studies beyond basic X-rays. We had previously visited and surveyed the national ANA hospital and infectious disease hospital and decided we would try and solicit his case to the surgeons at the closest International Security Assistance Force (ISAF) and American Role III facilities before admitting him for care at an indigenous facility.

At the closest ISAF hospital, he received another ultrasound in the emergency department (ED) that confirmed the initial report of a large hydatid cyst. A complete blood count (CBC), basic metabolic panel (BMP), and hepatic function panel (HFP) were performed and all were within normal parameters. After consultation with the chief of surgery, we took him to get a computed axial tomography (CAT) scan of his abdomen with IV contrast alone. Since the staff could



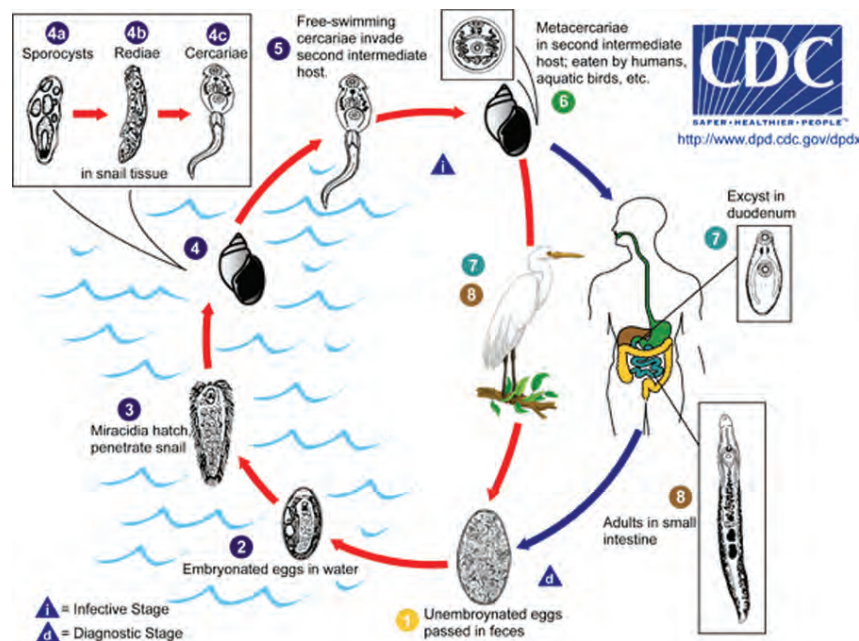
CT Scan of the abdomen done at the ISAF Hospital, Kabul International Airport

not take the images digitally, they photographed the CAT scan, and the cyst could easily be seen inside the body of his liver.

After presenting the case to the surgical staff of the regional ISAF role III facility, there was great academic interest, but no desire to place the facility's blood supply at risk. Both ISAF hospitals recommended that we refer the patient to the national ANA hospital in Kabul. Albendazole was started immediately and arrangements were made for admission and surgery at the ANA hospital. He was admitted to this hospital and had surgery to remove the cyst a week later.

DISCUSSION

A hydatid cyst, also known as echinococcosis, is a parasitic infestation of humans by the tapeworm *Echinococcus*. There are three principal species of *Echinococcus* that infect humans and cause disease. The most common species is *Echinococcus granulosus*, which causes cystic echinococcosis. The other two species are *Echinococcus multilocularis*, which causes alveolar echinococcosis, and *Echinococcus vogeli*, which causes polycystic echinococcosis. In the life cycle of the *E. granulosus*, humans, swine, sheep, etc. act as intermediate hosts and are infected by ingestion of food or water contaminated with canine and other carnivores' feces that contain the eggs of *E. granulosus*. The eggs are released from the adult tapeworm that is present in the carnivore's small intestine. Upon ingestion of the eggs, the infection process starts when the eggs make their way to the intestine. There they hatch and release an oncosphere, which makes its way through the intestinal wall and enters the circulatory system ending up in various organs, most commonly in the lungs and liver. There they develop into cysts. The cycle is completed once the infected organs are eaten by the definitive host, and protoscolices that were in the cysts attach to the intestine and mature into the adult tapeworm. The life cycles for *E. multilocularis* and *E. vogeli* are similar to *E. granulosus* only varying slightly in the types of animals that are definitive and intermediate hosts and the duration and proliferation of the larval stage in the intermediate host.



Occurrence of all forms of Echinococcosis is rare in the continental United States with less than one case per one-million inhabitants being reported and most of the cases occurring on the coast of Alaska and

in Canada around the Hudson Bay. Across the globe, the most endemic areas are the Middle East, the southern part of South America, Iceland, Australia, and the southern part of Africa. The incidence of cystic echinococcosis is around 1 to 220 cases per 100,000 inhabitants, while alveolar echinococcosis ranges from 0.03 to 1.2 cases per 100,000 inhabitants.¹

Presentation of infection varies greatly. A case may present asymptomatic for years, or the infection may show signs and symptoms within weeks. The type of parasite, site, and extent of infection determine the degree of signs and symptoms. In cystic echinococcosis, often a singular slow-growing mass develops in the body. The most common areas of cyst formation are the liver, being involved in around 65% of the cases, and the lungs are involved in 25% of the cases; however, cyst formation can occur in any organ, including the brain, bones, skeletal muscles, kidneys, and spleen.² The site of infection along with the size of the cyst itself will determine the signs and symptoms present. The pressure and displacement of the cyst to the organs is what typically causes the presentation of infection. A larger cyst can go asymptomatic in the lungs, liver, or other thoracic organs, whereas a cyst in the brain may present with signs and symptoms within a few days to weeks. An infection in the liver can present with abdominal pain and tenderness, hepatomegaly, jaundice, biliary obstruction, and portal hypertension. Cyst formation in the lungs can show chest pain, cough, shortness of breath, decreased lung sounds, and hemoptysis.

Furthermore, a cyst in the brain can cause headache, nausea, vomiting, neurological deficits, and a decreased level of consciousness.

Secondary complications can occur due to a leak or burst of the cyst itself. Extruded contents of the cyst can cause from a mild allergic reaction to a full-blown anaphylactic shock depending on the severity of the rupture. In alveolar echinococcosis, the liver is more specifically targeted and the disease process is more fulminant, resembling that of cirrhosis or carcinoma that eventually leads to liver failure. While cystic echinococcosis typically forms one encapsulated cyst, the disease process of alveolar echinococcosis typically has multiple compartments that spread locally and distantly that suggests a malignancy and is typically harder to treat.¹

In any type of echinococcosis, imaging is typically the first tool used for diagnosis, followed by the use of blood work and serologic tests for verification of imaging results. The preferred imaging techniques to

be used are ultrasound, CAT scan, and magnetic resonance imaging (MRI). The best results are yielded when there is a presence of daughter cells in the cyst in cystic echinococcosis or areas of calcification as seen in alveolar echinococcosis. In cysts that are less extensive, it may be difficult to differentiate between hydatid cysts and abscesses, amebic cysts, and benign or malignant tumors.³ This is why the use of serologic testing and blood work is essential for verification of imaging results. Serologic tests include the enzyme-linked immunosorbent assay (ELISA) and the immunoblot. Together they have a sensitivity of 80% overall and can distinguish between the echinococcal infections. Eosinophilia occurs in over 25% of cases and is determined from a CBC.¹ Imaging verified by serologic tests can lead to a definitive diagnosis.

Treatment of echinococcosis often involves the use of albendazole (*Albenza*) in conjunction with the surgical removal of the cyst. Albendazole has been shown to suppress the growth of cystic formation and is often administered before and after surgery to prevent metastatic infection in case of leakage of cystic contents. The dosage of albendazole is 10-15mg/kg/d given bid PO for one to six months. Mebendazole (*Vermox*) can be used in lieu of albendazole. The dosing of mebendazole is 40-50mg/kg/d PO given for three to six months. In cases where the cysts are inoperable or cystic formation is diffuse and extensive, percutaneous aspiration, injection, and reaspiration (PAIR)

technique has been proven to be effective. In this technique, the cyst's contents are aspirated and then injected with a scolicidal agent (20% hypertonic saline or albendazole metabolites including albendazole sulfoxide and albendazole sulfone) for 15 minutes and then the contents are reaspirated. This process is repeated until the return of contents is clear. This technique is less invasive and less expensive, but the occurrence of cystic rupture or leakage is greater.¹

Echinococcosis still remains a rather rare disease in North America. When deployed however, the prevalence of infection is greatly increased. If taking care to use simple preventive techniques such as proper hand washing, correct food preparation and storage, and limited exposure to wildlife, echinococcosis can remain a rare occurrence for troops at home and abroad.

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Editorial Review

The Time to Field Freeze Dried Plasma is Now

COL Andre' Pennardt, MD, FACEP, FAWM

Plasma is the component of blood that remains once all cells and platelets are removed and contains the factors required for effective coagulation during hemorrhage. It is a critical component of damage control resuscitation of seriously injured combat casualties. Plasma administration replaces depleted clotting factors and restores intravascular volume without the risk of creating a dilutional coagulopathy. In the setting of trauma care, plasma is a much better resuscitative fluid than the crystalloids (e.g., normal saline) and col-loids (e.g., hetastarch) currently deployed with U.S. forces for battlefield use. In the United States, plasma is typically stored in a fresh frozen form that must be carefully thawed and warmed prior to administration. Fresh frozen plasma (FFP) has to be administered within 24 hours of thawing, which means that pre-mission preparation for potential casualties could rapidly deplete theater stocks.

Since the carrying and thawing of frozen liquids is impractical on the battlefield and in other austere environments, Germany developed and licensed a freeze-dried version of plasma (LyoPlas N-w), which consists of a powder that can be rapidly reconstituted with water prior to intravenous administration, but is not approved by the U.S. Food and Drug Administration (FDA). A similar research and development effort is underway in the U.S. to produce an FDA approved, freeze dried plasma (FDP), but is not expected to result in fielding until the 2015 to 2017 timeframe. Significant legal barriers exist that prevent U.S. military medical personnel from using non-FDA approved medications and blood products on U.S. servicemembers. Even though seriously wounded American casualties are being successfully treated with LyoPlas N-w by German medical facilities in Afghanistan, U.S. Special Operations Forces (SOF) medics are prohibited from using this same product on the battlefield hours earlier as a potentially lifesaving measure. Recognizing the illogic of this disparity and the great potential FDP holds for trauma resuscitation, the Office of the U.S. Special Operations Command (USSOCOM) Command Surgeon is actively pursuing authorization for SOF to field LyoPlas N-w.

LyoPlas N-w is produced in Germany following the European Union Good Manufacturing Practices guidelines. Each unit of LyoPlas N-w comes from a single donor, who is screened for all required blood-borne pathogens, including HIV, Hepatitis A, B, and C, as well as Parvovirus B19. After lyophilization the unit is placed into a minimum four-month quarantine until the donor can be retested for these pathogens to ensure continued health and that no delayed seroconversion has occurred. These measures to reduce the risk of infectious disease transmission to the recipient meet or exceed U.S. blood banking standard practices. Unlike FFP, LyoPlas N-w additionally undergoes filtration to further remove cellular remnants and reduce the risk of infection or transfusion immune reactions. It remains efficient for at least 12 months when maintained in a temperature range of 4 to 25 degrees Celsius. Germany has to date fielded over 500,000 units of LyoPlas N-w without any unusual or significant adverse effects when compared to FFP. Multiple clinical studies have also demonstrated that LyoPlas N-w is at least as efficacious as FFP.

SOF requires a more effective combat casualty resuscitation fluid than colloids and crystalloids. While warm fresh whole blood is a viable option, buddy transfusions are not always feasible based on the operational environment. FDP has the potential to effectively fill a critical gap in the tools available to the SOF medic. The U.S. efforts to produce an FDA approved, lyophilized plasma will not come to fruition for at least five more years. Since a coalition partner already produces an apparently effective and safe FDP and uses it on U.S. combat casualties, senior DoD medical leaders should act quickly to approve the USSOCOM request to field it as well.

REFERENCE: This editorial is based on information obtained from the German FDA-equivalent package insert and a review article in the German *Journal of Transfusion Medicine*, as well as personal communications with the German military/Red Cross.

COL Andre' Pennardt is an emergency physician with over 15 years of Special Operations experience, including service with the 5th and 10th Special Forces Groups (A), 160th SOAR (A), and other USASOC units. He has completed more than 10 SOF deployments to Afghanistan and Iraq.

ABSTRACTS FROM CURRENT LITERATURE

Fatal Airway Injuries During Operation Enduring Freedom and Operation Iraqi Freedom

Robert L. Mabry, MD; Jason W. Edens, MD; Lisa Pearce, MD; Joseph F. Kelly, MD; Howard Harke, MD
Prehospital Emergency Care 2010;14:272-277

ABSTRACT

Introduction: Airway compromise is the third leading cause of potentially preventable death on the battlefield. An understanding of the injuries associated with fatal airway compromise is necessary to develop improvements in equipment, training, and prehospital management strategies in order to maximize survival. **Objective:** To determine injury patterns resulting in airway compromise in the combat setting. **Methods:** This was a subgroup analysis of cases previously examined by Kelly and colleagues, who reviewed autopsies of military personnel who died in combat in Iraq and Afghanistan between 2003 and 2006. Casualties with potentially survivable (PS) injuries and deaths related to airway compromise previously identified by Kelly et al. were reviewed in depth by a second panel of military physicians. **Results:** There were 982 cases that met the inclusion criteria. Of these, 232 cases had PS injuries. Eighteen (1.8%) cases were found to have airway compromise as the likely cause of primary death. All had penetrating injuries to the face or neck. Twelve deaths (67%) were caused by gunshot wounds, while six deaths (33%) were caused by explosions. Nine cases had concomitant injury to major vascular structures, and eight had significant airway hemorrhage. Cricothyroidotomy was attempted in five cases; all were unsuccessful. **Conclusion:** Airway compromise from battlefield trauma results in a small number of PS fatalities. Penetrating trauma to the face or neck may be accompanied by significant hemorrhage, severe and multiple facial fractures, and airway disruption, leading to death from airway compromise. Cricothyroidotomy may be required to salvage these patients, but the procedure failed in all instances in this series of cases. Further studies are warranted to determine the appropriate algorithm of airway management in combat casualties sustaining traumatic airway injuries.

Extrication Collars Can Result in Abnormal Separation Between Vertebrae in the Presence of a Dissociative Injury

Peleg Ben-Galim, MD; Niv Dreiangel, MD; Kenneth L. Mattox, MD; Charles A. Reitman, MD;
S. Babak Kalantar, MD; and John A. Hipp, PhD
Journal of Trauma 2010Aug;69(2):447-50

ABSTRACT

Background: Cervical collars are applied to millions of trauma victims with the intent of protecting against secondary spine injuries. Adverse clinical outcomes during the management of trauma patients led to the hypothesis that extrication collars may be harmful in some cases. The literature provides indirect support for this observation. The purpose of this study was to directly evaluate cervical biomechanics after application of a cervical collar in the presence of severe neck injury. **Methods:** Cranial-caudal displacements in the upper cervical spine were measured in cadavers from images taken before and after application of collars following creation of an unstable upper cervical spine injury. **Results:** In the presence of severe injury, collar application resulted in 7.3mm - 4.0mm of separation between C1 and C2 in a cadaver model. In general, collars had the effect of pushing the head away from the shoulders. **Conclusions:** This study was consistent with previous evidence that extrication collars can result in abnormal distraction within the upper cervical spine in the presence of a severe injury. These observations support the need to prioritize additional research to better understand the risks and benefits of cervical stabilization methods and to determine whether improved stabilization methods can help to avoid potentially harmful displacements between vertebrae.

Pressure Applied by the Emergency/Israeli Bandage

CAPT Nolan Shipman, USN (Ret.); Lt Col Charles S. Lessard, USAF (Ret.)
Military Medicine; 174, 1:86, 2009

Abstract

The primary objective of the study was to determine the amount of pressure exerted by a bandage modified with a “pressure bar.” The data were collected using Emergency Bandages with and without the pressure bar. In addition to measuring the pressure under the pressure bar, other pressure sensors were used to measure the pressure being exerted to other areas under the elastic Emergency Bandage (at 90°, 180°, and 270°), but not directly under the pressure bar to determine the effectiveness of the pressure bar bandage to apply localized pressure over a wound without applying unnecessary pressure over the other areas. Two sets of statistical tests conducted: “f-tests” assuming unequal variances from two samples and the “analysis of variance” (ANOVA), single factor. From the results, it is concluded that the Emergency Bandage pressure bar is very effective in elevating the applied pressure directly under the pressure bar while at the same time not applying unnecessary pressure over other areas covered by the bandage, which allows control of hemorrhage at the site of injury (under the pressure bar area) without having to have a full tourniquet effect. Perfusion of the capillaries of the hand and fingers were found to be adequate by observation of the fingers tips (finger nail quick) and subjective pulse measurement at the wrist (radial artery).

Survival With Emergency Tourniquet Use to Stop Bleeding in Major Limb Trauma

COL John F. Kragh, Jr., MD; Thomas J. Walters, PhD; David G. Baer, PhD; LTC Charles J. Fox, MD; Charles E. Wade, PhD; Jose Salinas, PhD; and COL John B. Holcomb, MD
Annals of Surgery 2009;249: 1–7

ABSTRACT

Objective: The purpose of this study was to determine if emergency tourniquet use saved lives. **Summary Background Data:** Tourniquets have been proposed as lifesaving devices in the current war and are now issued to all soldiers. Few studies, however, describe their actual use in combat casualties. **Methods:** A prospective survey of injured who required tourniquets was performed over 7 months in 2006 (NCT00517166 at ClinicalTrials.gov). Follow-up averaged 28 days. The study was at a combat support hospital in Baghdad. Among 2838 injured and admitted civilian and military casualties with major limb trauma, 232 (8%) had 428 tourniquets applied on 309 injured limbs. We looked at emergency tourniquet use, and casualties were evaluated for shock (weak or absent radial pulse) and pre-hospital versus emergency department (ED) tourniquet use. We also looked at those casualties indicated for tourniquets but had none used. We assessed survival rates and limb outcome. **Results:** There were 31 deaths (13%). Tourniquet use when shock was absent was strongly associated with survival (90% vs. 10%; $P = 0.001$). Prehospital tourniquets were applied in 194 patients of which 22 died (11% mortality), whereas 38 patients had ED application of which 9 died (24% mortality; $P = 0.05$). The 5 casualties indicated for tourniquets but had none used had a survival rate of 0% versus 87% for those casualties with tourniquets used ($P = 0.001$). Four patients (1.7%) sustained transient nerve palsy at the level of the tourniquet. No amputations resulted solely from tourniquet use. **Conclusions:** Tourniquet use when shock was absent was strongly associated with saved lives, and prehospital use was also strongly associated with lifesaving. No limbs were lost due to tourniquet use. Education and fielding of prehospital tourniquets in the military environment should continue.

Morphine Use after Combat Injury in Iraq and Post-Traumatic Stress Disorder

Troy Lisa Holbrook, PhD; Michael R. Galarneau, MS; Judy L. Dye, MS, RN, ANP; Kimberly Quinn, BSN; and Amber L. Dougherty, MPH
New England Journal of Medicine 362;2 NEJM.org January 14, 2010

ABSTRACT

Background: Post-traumatic stress disorder (PTSD) is a common adverse mental health outcome among seriously injured civilians and military personnel who are survivors of trauma. Pharmacotherapy in the aftermath of serious physical injury or exposure to traumatic events may be effective for the secondary prevention of PTSD. **Methods:** We identified 696 injured U.S. military personnel without serious traumatic brain injury from the Navy–Marine Corps Combat Trauma Registry Expeditionary Medical Encounter Database. Complete data on medications administered were available for all personnel selected. The diagnosis of PTSD was obtained from the Career History Archival Medical and Personnel System and verified in a review of medical records. **Results:** Among the 696 patients stud-

ied, 243 received a diagnosis of PTSD and 453 did not. The use of morphine during early resuscitation and trauma care was significantly associated with a lower risk of PTSD after injury. Among the patients in whom PTSD developed, 61% received morphine; among those in whom PTSD did not develop, 76% received morphine (odds ratio, 0.47; $P < 0.001$). This association remained significant after adjustment for injury severity, age, mechanism of injury, status with respect to amputation, and selected injury-related clinical factors. **Conclusions:** Our findings suggest that the use of morphine during trauma care may reduce the risk of subsequent development of PTSD after serious injury.

Spine Immobilization in Penetrating Trauma: More Harm Than Good?

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Journal of Trauma 2010;68: 115–121

ABSTRACT

Background: Previous studies have suggested that prehospital spine immobilization provides minimal benefit to penetrating trauma patients but takes valuable time, potentially delaying definitive trauma care. We hypothesized that penetrating trauma patients who are spine immobilized before transport have higher mortality than nonimmobilized patients. **Methods:** We performed a retrospective analysis of penetrating trauma patients in the National Trauma Data Bank (version 6.2). Multiple logistic regression was used with mortality as the primary outcome measure. We compared patients with versus without prehospital spine immobilization, using patient demographics, mechanism (stab vs. gunshot), physiologic and anatomic injury severity, and other prehospital procedures as covariates. Subset analysis was performed based on Injury Severity Score category, mechanism, and blood pressure. We calculated a number needed to treat and number needed to harm for spine immobilization. **Results:** In total, 45,284 penetrating trauma patients were studied; 4.3% of whom underwent spine immobilization. Overall mortality was 8.1%. Unadjusted mortality was twice as high in spine-immobilized patients (14.7% vs. 7.2%, $p = 0.001$). The odds ratio of death for spine-immobilized patients was 2.06 (95% CI: 1.35–3.13) compared with nonimmobilized patients. Subset analysis showed consistent trends in all populations. Only 30 (0.01%) patients had incomplete spinal cord injury and underwent operative spine fixation. The number needed to treat with spine immobilization to potentially benefit one patient was 1,032. The number needed to harm with spine immobilization to potentially contribute to one death was 66. **Conclusions:** Prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma.

Prehospital Spinal Immobilization Does Not Appear to be Beneficial and May Complicate Care Following Gunshot Injury to the Torso

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Journal of Trauma 2009;67: 774–778

ABSTRACT

Background: Prehospital spinal immobilization (PHSI) is routinely applied to patients sustaining torso gunshot wounds (GSW). Our objective was to evaluate the potential benefit of PHSI after torso GSW versus the potential to interfere with other critical aspects of care. **Methods:** A retrospective analysis of all patients with torso GSW in the Strong Memorial Hospital (SMH) trauma registry during a 41-month period and all patients with GSW in the National Trauma Data Bank (NTDB) during a 60-month period was conducted. PHSI was considered potentially beneficial in patients with spine fractures requiring surgical stabilization in the absence of spinal cord injury (SCI).

Results: Three hundred fifty-seven subjects from SMH and 75,210 from NTDB were included. A total of 9.2% of SMH subjects and 4.3% of NTDB subjects had spine injury, with 51.5% of SMH subjects and 32.3% of NTDB subjects having SCI. No SMH subject had an unstable spine fracture requiring surgical stabilization without complete neurologic injury. No subjects with SCI improved or worsened, and none developed a new deficit. Twenty-six NTDB subjects (0.03%) had spine fractures requiring stabilization in the absence of SCI. Emergent intubation was required in 40.6% of SMH subjects and 33.8% of NTDB subjects. Emergent surgical intervention was required in 54.5% of SMH subjects and 43% of NTDB subjects. **Conclusions:** Our data suggest that the benefit of PHSI in patients with torso GSW remains unproven, despite a potential to interfere with emergent care in this patient population. Large prospective studies are needed to clarify the role of PHSI after torso GSW.

Fractures of the Thoracolumbar Spine Sustained by Soldiers in Vehicles Attacked by Improvised Explosive Devices

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SPINE Volume 34, Number 22, pp 2400–2405

ABSTRACT

Study Design: Retrospective analysis. **Objective:** To analyze the types of orthopedic spine fractures sustained by North Atlantic Treaty Organization soldiers when vehicles are attacked by improvised explosive devices (IEDs), with specific focus on the flexion-distraction type thoracolumbar fracture (Chance fracture). **Summary of Background Data:** Operation Enduring Freedom is the North Atlantic Treaty Organization's effort in Afghanistan. IED attacks on armored vehicles are common and account for high proportion of soldiers' deaths and injuries. **Methods:** Retrospective record review was accomplished on soldiers admitted to a military hospital with orthopedic spine fractures after IED attacks on vehicles from January 1, 2008 to May 15, 2008. Thoracolumbar fractures were classified using the McAfee classification system. **Results:** Twelve male patients with 16 thoracolumbar fractures were identified (3 patients with multiple fractures). The 16 thoracolumbar fractures included 6 flexion-distraction fractures in 5 patients (38%, 6/16: two T12, two L1, one L3, and one L4), 7 compression fractures in 5 patients (44%, 5/16: one T7, one T8, two L1, one L2, one L3, and one L4), and 3 burst fractures (19%, 3/16: two L1 and one L2). **Conclusion:** The incidence of flexion-distraction thoracolumbar (Chance) fractures has been reported to be between 1.0% and 2.5% in most spine fracture series. In this small study, Chance fractures represented 38% of all thoracolumbar fractures sustained after IED attack on armored vehicles. The blast pattern associated with IED explosion may be responsible for the high rate of these injuries in vehicle occupants.

Battle Casualty Survival With Emergency Tourniquet Use to Stop Limb Bleeding

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Journal of Emergency Medicine Aug 28, 2009

ABSTRACT

Background: In a previous study conducted at a combat support hospital in Iraq, we reported the major lifesaving benefits of emergency tourniquets to stop bleeding in major limb trauma. Morbidity associated with tourniquet use was minor. **Study Objectives:** The objective of this study is to further analyze emergency tourniquet use in combat casualty care. **Design and Setting:** This report is a continuation of our previous study of tourniquet use in casualties admitted to a combat support hospital (NCT00517166 at www.ClinicalTrials.gov). **Methods:** After verifying comparable methodologies for the first study and the current study, we compared patient results for these two time periods and then pooled data to analyze outcomes with a larger sample size. **Results:** The total study population was 499 (232 in the previous study and 267 in the current study). In all, 862 tourniquets were applied on 651 limbs. Survival was 87% for both study periods. Morbidity rates for palsies at the level of the tourniquet were 1.7% for study 1 and 1.5% for study 2; major limb shortening was 0.4% for both. Survival was associated with prehospital application (89% vs. 78% hospital, $p < 0.01$) and application before the onset of shock (96% vs. 4% after). **Conclusions:** This study shows consistent lifesaving benefits and low risk of emergency tourniquets to stop bleeding in major limb trauma.

CORRECTIONS

* In the *Spring 2010, Volume 10, Edition 2* “Book Review” section on page 40, MAJ W. D. Thompson was incorrectly listed as a co-author and LTC Craig Myatt was listed as a reviewer of *Don’t Tread on Me, A 400 Year Look at America at War*. It should have correctly read:

H. W., III Crocker

ISBN13: 9781400053636 ISBN10: 1400053633

Publisher: Random House

Review by MAJ W. D. Thompson

** In the *Spring 2010, Volume 10, Edition 2* “Need to Know” section on page 83 the *JSOM* inadvertently neglected to give credit for the hard work behind the discovery of the counterfeit tourniquets.

The E-CAT vs. the CAT Tourniquet Evaluation

Lt Col Douglas Hodge (USAF), the Director of Joint Medical Test and Evaluation (JMTE) of the Defense Medical Material Program Office (DMMPO) was the first to react to rumors that a counterfeit Combat Application Tourniquet (CAT) was being introduced to the field in OEF. Lt Col Hodge employed David Morehouse, PhD, an independent research contractor, to assist him in tracking down the source of the fake CATs (if they did indeed exist). After several months of searching, an internet portal was discovered where the fake CATs could be purchased. Dr. Morehouse, purchased the counterfeit CATs through a company called “World Element”. Utilizing a patent pending device designed by 2SRG and a NASA engineer, a comparative test was conducted between the Element or “E-CAT” and the (NARP distributed) CAT.

The photo analysis, measurements, and strength tests revealed significant differences between the two tourniquets — most significant difference is the weaknesses in the polycarbonate windlass of the E-CAT, which prevented it from effectively tightening the tourniquet enough to occlude arterial bleeding.

Maj Brandi Ritter (USAF), Deputy Director of Joint Medical Test and Evaluation was the main source of interface between multiple investigative agencies and DMMPO as well as co-author of much of the final report.

Lt Col Hodge, Dr. Morehouse, and Maj Ritter started with a simple rumor, and ultimately defined, exposed, and published the information necessary to remove a potentially fatal “counterfeit” medical device from the hands of our Warfighters.

*** Correction to the *JSOM Winter 2010 Training Supplement*!

Please see page 109 in this edition’s “TCCC Updates” section for the new corrected *Seizure Protocol*. This is a correction to the *Seizure Protocol* on page A65 of the 2010 Training Supplement, TMEPS section.

Exploration of Prehospital Vital Sign Trends for the Prediction of Trauma Outcomes

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Reproduced with permission from *Prehospital Emergency Care* 2009, Vol. 13, No. 3, Pages 286–294

ABSTRACT

Objectives: We explored whether there are diagnostically useful temporal trends in prehospital vital signs of trauma patients.

Methods: Vital signs were monitored during transport to a level I trauma center and electronically archived. Retrospectively, we identified reliable vital signs recorded from the 0- to 7-minute interval and from the 14 to 21-minute interval during transport, and, for each subject, we computed the temporal differences between the two intervals' vital signs, the intrasubject 95% data ranges, the values during the initial 2 minutes, and the 21-minute overall means. We tested for differences between subjects with major hemorrhage versus control subjects, and computed receiver operating characteristic (ROC) curves. We conducted sensitivity analyses, exploring alternative clinical outcomes, temporal windows, and methods of identifying reliable data. **Results:** Comparing major hemorrhage cases versus controls, there were no discriminatory differences in temporal vital sign trends. Hemorrhage cases had significantly wider intrasubject data ranges for systolic blood pressure (SBP), respiratory rate (RR), and shock index (SI) versus controls. All results were consistent in several sensitivity analyses. **Conclusions:** Our findings add to a growing body of evidence that prehospital vital sign trends over 21 minutes or less are unlikely to be diagnostically useful because of substantial nondirectional fluctuations in vital signs that would obscure any subtle, progressive temporal trends. SBP, RR, and SI values were significantly different for high-acuity patients, and had more variability. Taken together, these findings suggest that higher-acuity patients experience episodes of instability rather than gradual, steady decline. Measures that account for data variability, such as taking the average of multiple measurements, may improve the diagnostic utility of prehospital vital signs.

INTRODUCTION

Progressive traumatic pathologies, such as uncontrolled hemorrhage, can cause directional changes in vital signs, such as progressive hypotension and tachycardia. These temporal trends may be of diagnostic value. This paper explores whether there are significant temporal trends in the prehospital vital signs of trauma patients and, more importantly, whether these temporal trends are diagnostically useful. There has been speculation that sophisticated temporal trend-based analysis of physiologic data may offer superior diagnostic utility,^{1,2} and some evidence to support this. Rhee and colleagues reported that trauma score change during transport added significantly to the initial trauma score as a predictor of mortality.³ A worsening of the shock index (SI), defined as the ratio of heart rate (HR) to systolic blood pressure (SBP),⁴ from the scene to the emergency department has been associated with significantly higher acuity.⁵ Indeed, well known monitors now display vital sign trends,⁶ implicitly endorsing the idea that there is value in trend information, even as temporal trend-based monitoring has shown mixed clinical value in the intensive care unit (ICU) setting.^{7,8}

Conversely, there are also changes in vital signs that do not trend through time, such as variability caused by discrete events (e.g., sympathetic activation due to painful manipulation of an injured extremity or sympatholysis due to a dose of pain medication) as well as measurement errors. If such nondirectional variability is large enough, it can mask subtle temporal trends. The literature suggests that indeed

there is notable temporal variation in prehospital vital signs. In a seminal paper on prehospital severity scores, Morris and colleagues found that a Revised Trauma Score that is either improving or getting worse is an indicator of high severity.⁹ Even when a trauma patient is normotensive upon arrival at a receiving facility, a preceding episode of prehospital hypotension has been associated with increased severity.^{10,11} This suggests that there is a population of high-severity trauma patients with abnormal vital signs but without steady, gradual declines. In theory, if typical trauma patients show noisy, large-amplitude vital sign temporal variations, it would be difficult to determine the “true” underlying directional trend in those vital signs (at least without a sufficiently wide temporal window of observation).

In this paper, our goal was to quantify prehospital vital sign temporal trends and vital sign temporal variability in a prehospital population of trauma patients with life-threatening pathology and compare them with those of control trauma patients who had less-severe injuries. We quantitatively examined group differences, as well as the discriminatory power of the various parameters. We tried to interpret our findings in a manner that is also consistent with the aforementioned reports.^{3,7,9–11} We considered some of the implications and practical strategies for interpreting prehospital vital signs, which may be valuable to the transport team and caregivers in the receiving hospital. Ultimately, transport monitors would display measurements that have been proven the most diagnostically valuable from a temporal sequence of vital signs.

METHODS

Study Design

This study was based on physiologic time-series data collected from 898 trauma-injured patients during transport between August 2001 and April 2004 by medical helicopter from the scene of injury to the level I unit at the Memorial Hermann Hospital in Houston, Texas.¹² Investigational review board (IRB) approval for this data collection was given by the Memorial Hermann Hospital and the U.S. Army Medical Research and Materiel Command Office of Research Protection. Additional attribute data were collected retrospectively via chart review. The vital signs were measured by Propaq 206EL transport monitors (Protocol Systems, Beaverton, OR), downloaded to an attached personal digital assistant, and ultimately stored in our database.¹³ The variables consisted of electrocardiogram (ECG), photoplethysmogram, and respiratory waveform signals recorded at 182, 91, and 23Hz, respectively, and their corresponding monitor-calculated vital signs, recorded at 1-second intervals (HR, oxygen saturation of arterial hemoglobin [SaO₂], and respiratory rate [RR]). In addition, SBP, mean arterial pressure (MAP), and diastolic blood pressure (DBP) were collected intermittently at multiminute intervals. Pulse pressure (PP), the difference between SBP and DBP, was computed retrospectively, as was the SI, which was reported to be useful for the diagnosis of hemorrhagic hypovolemia.^{4,12} The patient attribute data included demographics, injury descriptions, prehospital interventions, and hospital treatments. There were 100 attribute parameters for each patient, and these data have undergone prior analysis.^{2,12,14} For this study, we obtained de-identified patient data from Memorial Hermann Hospital.

Study Setting and Population

For each vital sign (SBP, RR, PP, HR, SaO₂, and SI), we studied the subpopulation of subjects possessing at least one reliable measurement recorded during the 0 to 7 minute interval, and at least one reliable measurement recorded during the 14 to 21 minute interval. The reason we studied different subpopulations for each vital sign was that only a small subset ($n = 97$, or 11%) of the original population possessed reliable data for each investigational vital sign. The reason we did not examine longer intervals is that there were relatively insufficient patient records of longer duration, as the average length of the vital sign records is about 26 minutes. We tested whether there were differences in population characteristics of the selected subpopulations versus the overall population using the chi-square test.

The reliability of prehospital vital signs has been questioned, e.g., by Low and Martin¹⁵ and by Garner.¹⁶ Even in-hospital vital signs are prone to erroneous measurement.^{17,18} Therefore, we employed previously developed methods^{19,20} that rigorously and systematically evaluate the reliability of prehospital monitor data. These automated algorithms rate each vital sign datum on an integer scale of 0 to 3. In this investigation, we studied data with a reliability level of ≥ 2 :

- The HR reliability algorithm evaluates the ECG waveform and considers whether there is agreement between several different methods of computing HR. The algorithm was previously compared with blinded human experts for several hundred ECG waveform excerpts.²⁰ When the HR algorithm identified reliable

data, in 97% of the cases, blinded human experts concurred that the waveform was clean and, in 100% of those cases, concurred with the monitor's reported HR. When the algorithm identified unreliable data, the human experts agreed 83% of the time, suggesting that the algorithm was more selective than the human experts.

- The RR reliability algorithm evaluates the impedance pneumogram, the source of the monitor's computed RR, and identifies rhythmic and clean segments.¹⁹ RR that is computed exclusively from these clean, rhythmic segments has been shown to be statistically superior to standard measures of RR as a predictor of hospital intubation and major hemorrhage.²¹

- The blood pressure reliability algorithm compares the HR measured by an oscillometric noninvasive blood pressure cuff versus the ECG HR and also checks that the relationships between SBP, MAP, and DBP are physiologic.²² Reliable SBP, as determined by this algorithm, was found to be statistically superior to unreliable SBP as a predictor of major hemorrhage.²³

- Computation of prehospital severity scores — the Revised Trauma Score²⁴ and the Prehospital Index,²⁵ which assign numerical severity scores for a trauma patient based on the patient's vital signs and mental status — as predictors of major hemorrhage and mortality, using vital signs deemed reliable by the algorithms, has been shown to be diagnostically equivalent to scores based on medic documentation and statistically superior to scores computed from vital signs that were deemed unreliable by the algorithms.²²

- SaO₂ reliability is determined by the duration (or absence) of a clean photoplethysmographic waveform. With the use of this algorithm, the positive predictive value of prehospital hypoxia (SaO₂ < 91%) rises from less than 75% (for conventional SaO₂ measurements) to over 95% (for "reliable" SaO₂) as a predictor of in-hospital documentation of thoracic or intracerebral injury.²⁶

Major hemorrhage was this study's primary outcome, defined as receipt of a blood transfusion within 24 hours after arrival at the hospital, along with documented injuries that were explicitly hemorrhagic. Such explicit injuries were one or more of the following: 1) laceration of solid organs, 2) thoracic or abdominal hematomas, 3) explicit vascular injury that required operative repair, or 4) limb amputation. In this primary analysis, patients who received blood but did not meet the documented injury criteria, i.e., ambiguous hemorrhagic patients, and patients who died before arrival at the hospital, were excluded from the analysis (121 patients excluded). Alternative outcome definitions, for major hemorrhage and for hospital respiratory interventions, were explored through a set of secondary sensitivity analyses, described below in the Sensitivity Analysis section.

Measurements and Data Analysis

We computed the average vital signs over 21 minutes of transport for each investigational population. We also computed the average vital sign trends, where the trend was computed as

the difference between a subject's average measurements during the 0 to 7 minute interval and the subject's average measurements during the 14 to 21 minute interval. (In the sensitivity analysis, described below, we explored other manners of computing trends.) We also computed the intrasubject standard deviation, σ , for each 21 minute vital sign and assumed that the intrasubject 95% data range was equal to 2σ .

The discriminatory performances of the investigational parameters were evaluated by constructing the receiver-operating characteristic (ROC) curves and calculating the area under the curve (AUC) using a maximum-likelihood method. We used the ROCKIT freeware²⁷ (University of Chicago) for these analyses. ROCKIT assumes a binormal ROC model; that is, data for each of the decision outcomes (hemorrhage and control) are considered to be normally distributed. ROCKIT automatically selects multiple decision thresholds based on the distribution of the input data and estimates the parameters of the ROC curve. The curves estimated from this method are smoother than empirically evaluated ROC curves and can better represent the relationship between vital sign variables and the decision outcomes.^{28,29} We performed univariate ROC analyses for each vital sign and reported the estimated AUC and the corresponding 95% confidence interval (CI). We compared ROC curves of each vital sign's initial value (the average of measurements taken during the initial 2 minutes) versus the average of all 21-minute vital sign measurements, employing a paired AUC test. Statistical differences between hemorrhage and control patients were compared using two-tailed unpaired Student's t-test and the Mann-Whitney U test.³⁰

Sensitivity Analysis

We repeated the preceding computations 1) using different clinical outcomes; 2) using different data quality criteria; 3) using different temporal windows of analysis; and 4) excluding patients with abnormal initial vital signs. Specifically, in 1), we repeated the calculations comparing trauma patients who required major respiratory interventions (either hospital intubation or chest tubes) versus the control patients who did not receive these interventions. In addition, we explored an alternative definition of major hemorrhage: Cases in which the patients received emergency red blood cell transfusions, regardless of their documented anatomic injuries, versus control patients who did not receive a blood transfusion. In 2), we relaxed our data inclusion criteria; this increased our population sizes. We simply required that the subjects possess nonzero vital sign data, studying the most reliable data available for each subject (as determined by our automated algorithms). Similarly, we repeated the calculations using all 21 minutes of data, without any filtering of the vital signs based on reliability. In 3), we investigated different temporal windows, seeking significant trend differences between major hemorrhage cases and controls, examining trends computed from time 0 to 5 minutes to time 5 to 10 minutes; from time 5 to 10 minutes to time 10 to 15 minutes; from time 0 to 5 minutes to time 10 to 15 minutes; and from the initial 2 minutes to the rest of each patient's record (all times are relative to time $t = 0$, when the air crew first applied the Propaq monitor to the trauma patient). Finally, in 4), we excluded patients with frankly abnormal vital signs in the initial mmHg, and repeated the calculations.

RESULTS

Scene arrival time was a median of 41 minutes (interquartile range 33 to 51 minutes) after the recorded incident time. Total scene time was a median of 12 minutes (interquartile range 9 to 20 minutes), during which interval patient monitoring with the Propaq was initiated. Table 1 details the characteristics of the study population. Relative to the overall database, the primary investigational populations had lower rates of mortality and respiratory intervention ($p < 0.05$, chisquare test) but no significant differences in terms of hemorrhage incidence, mechanism of injury, and gender. (We also examined multiple populations who did not possess these differences in the mortality and respiratory intervention rates versus the total population, as described in the Sensitivity Analysis section below.) Regarding the incidence of major head injury, 17% of the overall database had Abbreviated Injury Scores (AISs) ≥ 3 for head injury, and in subpopulations, 17 to 19% of those patients had head AISs ≥ 3 , which was not significantly different.

Figure 1 illustrates the magnitudes of the average intrasubject 95% data ranges versus the average temporal trends for the corresponding subpopulations over 21 minutes of transport time. When comparing major hemorrhage cases with control cases, we found that major hemorrhage cases had significantly wider SBP, RR, and SI data variability (i.e., the intrasubject 95% data ranges) than control cases ($p < 0.0001$, $p = 0.01$, and $p < 0.00001$, respectively, by Student's t-test; Mann-Whitney U test yielded similar results). For the other vital signs, PP, HR, and SaO₂, there were no significant differences in the intrasubject 95% data ranges. Vital sign trends did not offer clinically useful discriminatory power (ROC AUCs) to distinguish the major hemorrhage cases from the control cases (Table 2). There were no significant differences in vital sign temporal trends (SBP, RR, PP, HR, SaO₂, and SI trends) between the major hemorrhage cases and the control cases (by Student's t-test and Mann-Whitney U test).

Average vital signs show discriminatory value, with ROC AUC ranging from 0.66 to 0.84 (Table 3). SBP(mean) and PP(mean) (the averages of SBP and PP measured during 21 minutes of transport) were better discriminators of hemorrhage than the initial measurements of SBP and PP, respectively (ROC AUC 0.82 versus 0.71, and AUC 0.84 versus 0.78, respectively, $p < 0.05$ for both comparisons). The averages of SaO₂ and SI were not statistically significantly better than their initial values, in terms of raising the AUC. All vital signs in Table 3 were significantly different in major hemorrhage versus control cases, except for SaO₂ (2 min). Comparing Table 2 and Table 3, we found that the average vital signs offer more discriminatory power (higher ROC AUC) than the vital sign trends ($p < 0.05$ in all AUC comparisons).

Sensitivity Analysis

Our major findings were insensitive to the following: 1) alternative clinical outcomes (major respiratory interventions and the alternative definition of major hemorrhage); 2) different data quality criteria (relaxing the data quality inclusion requirements and thus increasing our population sizes; when we excluded fewer subjects, the mortality and the respiratory intervention rates of the study population were the same as those of the total population); 3) different temporal win-

Population*	No. Patients	Male Gender†	Penetrating Mechanism	Major Hemorrhage‡	Respiratory Intervention	Mortality
Total	898	660 (73%)	101 (11%)	90 (10%)	266 (30%)	94 (10%)
SBP trends	345	251 (73%)	33 (10%)	41 (12%)	78 (23%§)	14 (4%§)
RR trends	149	118 (79%)	14 (9%)	21 (14%)	37 (25%)	8 (5%)
PP trends	345	251 (73%)	33 (10%)	41 (12%)	78 (23%§)	14 (4%§)
HR trends	221	163 (74%)	20 (9%)	27 (12%)	54 (24%)	11 (5%§)
SaO ₂ trends	240	176 (73%)	18 (8%)	17 (7%)	57 (24%)	14 (6%§)
SI trends	169	122 (72%)	18 (11%)	19 (11%)	38 (22%)	7 (4%§)

*For each vital sign, eligible subjects had at least one reliable measurement recorded during the 0 to 7 minute interval and another reliable measurement recorded during the 14 to 21 minute interval.

†There was no assigned gender for four patients in the database.

‡Excluded from analysis were 121 patients who received hospital blood but did not have documented injuries that were unambiguously hemorrhagic.

§ Statistically significant versus the total population's rates. In the sensitivity analyses, we analyzed patient population whose mortality and respiratory intervention rates were the same as the overall population's; details are available in the text.

HR = heart rate (in beats·min⁻¹); PP = pulse pressure (in mmHg); RR = respiratory rate (in breaths·min⁻¹); SaO₂ = oxygen saturation of arterial hemoglobin (in

%); SBP = systolic blood pressure (in mmHg); SI = shock index (in beats·min⁻¹mmHg⁻¹).

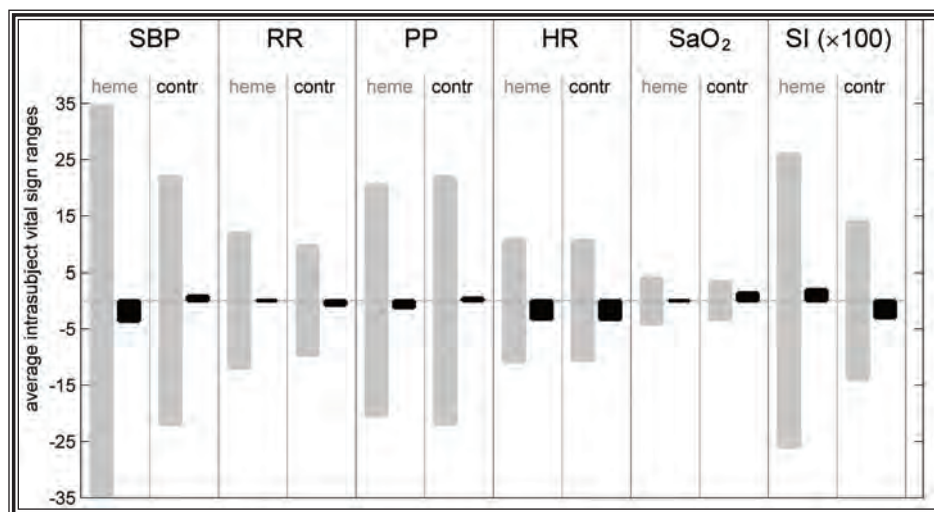


Figure 1: Major hemorrhage cases (“heme”) versus control cases: intrasubject 95% vital sign ranges (gray bars) versus vital sign trends (black bars) averaged over all subjects in the corresponding study populations (systolic blood pressure [SBP] in mmHg; pulse pressure [PP] in mmHg; heart rate [HR] in beats·min⁻¹; respiratory rate [RR] in breaths·min⁻¹; oxygen saturation of arterial hemoglobin [SaO₂] in %; shock index [SI] in beats·min⁻¹ mmHg⁻¹ · multiplied by 100 [so the scale will be comparable for all illustrated vital signs]).

dows of analysis (examining trends computed from time 0 to 5 minutes to time 5 to 10 minutes; from time 5 to 10 minutes to time 10 to 15 minutes; from time 0 to 5 minutes to time 10 to 15 minutes; and from the initial 2 minutes to the rest of each patient's record); and 4) the exclusion of patients with frankly abnormal vital signs in the initial 2 minutes. Again, there were no changes to any findings.

These numerous sensitivity analyses were consistent with the major findings of Table 2 and Table 3. To summarize, in all sensitivity analyses we found the following:

- For all vital signs, trends were nondiscriminatory (i.e., ROC AUCs were not significantly better than 0.50, consistent with Table 2).
- For all vital signs, their 21 minute averages were significantly different in major hemorrhage (or major res-

piratory intervention) versus control cases (i.e., consistent with Table 3).

- For all vital signs, the magnitude of the 95% data range (averaged over all subjects) was considerably larger than the magnitude of any temporal trend (i.e., consistent with Fig. 1).
- For SBP, RR, and SI, there were significantly wider ranges (i.e., more data variability) in major hemorrhage (or major respiratory intervention) versus control cases (i.e., consistent with Fig. 1).
- Using the 21 minute average of four prehospital vital signs (RR, HR, SaO₂, and SI) versus their initial values yielded improvements in ROC AUCs, anywhere from +0.02 to +0.10, although these improvements were not statistically significant.

TABLE 2. Major Hemorrhage Cases versus Controls: Vital Sign Temporal Trends Are Nondiscriminatory

	Major Hemorrhage	Control	ROC AUC (95% CI)*
SBP trend	-3.6 (SD 24.69)	0.9 (SD 15.89)	0.55 (0.45-0.66)
RR trend	0.1 (SD 6.44)	-0.8 (SD 5.76)	0.55 (0.41-0.68)
PP trend	-1.2 (SD 12.00)	0.5 (SD 14.67)	0.53 (0.44-0.62)
HR trend	-3.2 (SD 7.52)	-3.3 (SD 9.10)	0.50 (0.39-0.61)
SaO ₂ trend	0.0 (SD 2.63)	1.4 (SD 5.56)	0.57 (0.41-0.72)
SI trend	0.02 (SD 0.24)	-0.03 (SD 0.12)	0.51 (0.36-0.67)

*Area under the receiver-operating characteristic curve and the 95% confidence interval.

AUC = area under the curve; CI = confidence interval; HR = heart rate (in beats·min⁻¹); PP = pulse pressure (in mmHg); ROC = receiver-operating characteristic; RR = respiratory rate (in breaths·min⁻¹); SaO₂ = oxygen saturation of arterial hemoglobin (in %); SBP = systolic blood pressure (in mmHg); SD = standard deviation; SI = shock index (in beats·min⁻¹mmHg⁻¹).

TABLE 3. Initial Vital Sign "(2min)" versus Average Vital Sign during 21 Minutes of Transport "(mean)" for the Major Hemorrhage Cases versus Control Cases

	Major Hemorrhage	Control	ROC AUC (95% CI)*
SBP _(2min)	115 (SD 26)	134 (SD 23)	0.71 (0.61-0.79)†
SBP _(mean)	111 (SD 19)	135 (SD 21)	0.82 (0.74-0.87)†
RR _(2min)	32 (SD 9)	27 (SD 6)	0.70 (0.55-0.83)
RR _(mean)	30 (SD 9)	25 (SD 6)	0.66 (0.51-0.79)
PP _(2min)	43 (SD 13)	58 (SD 16)	0.78 (0.70-0.84)†
PP _(mean)	41 (SD 11)	58 (SD 14)	0.84 (0.77-0.90)†
HR _(2min)	109 (SD 20)	92 (SD 19)	0.75 (0.65-0.83)
HR _(mean)	107 (SD 20)	90 (SD 17)	0.75 (0.64-0.84)
SaO ₂ _(2min)	96 (SD 3)	97 (SD 11)	0.72 (0.59-0.82)
SaO ₂ _(mean)	97 (SD 2)	99 (SD 3)	0.75 (0.61-0.86)
SI _(2min)	0.97 (SD 0.29)	0.72 (SD 0.21)	0.77 (0.65-0.86)
SI _(mean)	0.93 (SD 0.22)	0.70 (SD 0.19)	0.79 (0.67-0.88)

* Area under the receiver-operating characteristic curve and the 95% confidence interval.

† p < 0.05, comparing vital signs from the initial 2 minutes versus the average of all 21 minute measurements.

AUC = area under the curve; CI = confidence interval; HR = heart rate (in beats·min⁻¹); PP = pulse pressure (in mmHg); ROC = receiver-operating characteristic; RR = respiratory rate (in breaths·min⁻¹); SaO₂ = oxygen saturation of arterial hemoglobin (in %); SBP = systolic blood pressure (in mmHg); SD = standard deviation; SI = shock index (in beats·min⁻¹mmHg⁻¹).

Several minor findings from the sensitivity analyses, however, were different from the primary results in Table 2 and Table 3:

- For cases requiring respiratory interventions versus their controls, there was more variability in SaO₂ (p < 0.05).
- In Table 3 (the primary findings), using the 21 minute average of RR versus the initial RR value did not improve the ROC AUC. When we changed the definition of major hemorrhage, using the 21 minute average of RR versus the initial RR value again did not improve the ROC AUC. However, for all other sensitivity analyses, using the 21 minute average of RR versus the initial RR value did (nonsignificantly) increase the ROC AUCs.

• In all sensitivity analyses, using the 21 minute average of SBP or PP versus the initial SBP or PP did increase the ROC AUCs. However, this improvement in ROC AUC was not statistically significant in a minority of the sensitivity analyses.

• When we analyzed all subjects in the database (i.e., not excluding subjects for failing to meet the data quality criteria), we found a significant association between the drop of PP by 7mmHg over the entire transport versus hemorrhage (44% of major hemorrhage cases versus 28% of controls, p = 0.02 by the chi-square test). In the same larger population, we found a significant association between the drop of SBP by 10mmHg over the entire transport and hemorrhage (28% of major hemorrhage cases versus 10% of controls, p < 0.01). We did not identify this association in the primary analysis or when examining other temporal windows, data quality criteria, or the other clinical endpoints.

DISCUSSION

We found that vital sign temporal trends were diagnostically weak and did not discriminate between sicker trauma patients and their controls, although the average of vital signs measured over 21 minutes showed higher discriminatory value than the initial vital signs. This may be, in large part, because there was considerable up-and-down, nondirectional temporal variability in the typical patient record relative to the magnitude of any temporal trends (illustrated in Fig. 1). Such vital sign variability during transport can "mask" any underlying temporal trend, making it difficult to estimate a vital sign's true temporal trajectory. Temporal trends were not statistically different between the hemorrhage and the control cases, and we did not find them useful for the discrimination of major hemorrhage (i.e., having low ROC AUCs).

We found that trauma patients with major injuries have lower SBPs and higher RRs (which is not surprising). We also found that higher-acuity subjects have significantly more variability (e.g., wider 95% intrasubject ranges) in SBP, RR, and SI. We conjecture that sick trauma patients suffered episodic decompensation (e.g., hypotensive or hypoxic intervals) as well as episodic recoveries, manifested as large swings in vital signs that increased the overall data range (i.e., vital sign variability) even in the absence of strong directional trends overall. We speculate that this variability might have been caused by any combination of true physiologic variability (e.g., fluctuations in pain, fear, relaxation, or pharmacologic intervention) as well as measurement errors.

If there are no major temporal trends, then taking the average of multiple serial vital signs can eliminate some of the random variability and yield a better estimate of the subject's "true" underlying vital signs, and may improve diagnostic classification. In this investigation, using the average of all SBP or all PP measurements during the 21 minutes of transport significantly improved discrimination (ROC AUCs) versus the initial values and the vital sign trends. Moreover, in the primary analysis and all sensitivity analyses, there were nonsignificant improvements in AUCs for the other average

vital signs (SaO₂ and SI) versus vital signs measured in the initial 2 minutes. In summary, taking the average of serial prehospital SBPs, and perhaps other vital signs, may offer improvements in discriminatory capability.

It is important to consider how generalizable these findings are. Do our findings relate to other serious outcomes, and to clinical settings beyond air medical transport? Regarding the former, we report that there are major fluctuations in vital signs (e.g., the 95% range for SBP was ± 34 mmHg for major hemorrhage cases and ± 22 mmHg for control cases). These major fluctuations were found throughout a wide set of sensitivity analyses (different outcomes, different data reliability criteria, etc.). Because our patient records are characterized by such fluctuations, we argue that it is unlikely that any outcomes definition or data selection method will yield trend information that is sensitive and specific for any diagnosis. Simply put, it will be nearly impossible to identify progressive, gradual trends when the data fluctuate so dramatically.

The second question relates to the generalizability of our findings to clinical settings beyond air medical transport. Is the vital sign variability in this data set representative of other prehospital experiences? We found an absence of diagnostic trends, but we did find that sicker patients showed more vital sign variability. This is entirely analogous to what was found by Morris et al.,⁹ in an analysis of urban trauma patients during prehospital ground transport. Morris and colleagues found diagnostic equivalency between Trauma Scores computed earlier in time and those computed later, as predictors of a high Injury Severity Score. This implies that there were no powerful trends, (i.e., that higher-acuity patients did not develop progressively abnormal SBP and RR -determinants of the Trauma Score). Moreover, Morris et al., reported that patients with either improvement or deterioration in their Trauma Score were at increased risk of death. This implies that there must have been more vital sign variability in high-severity cases. Rhee and colleagues³ commented on this finding of Morris et al., as follows: “No explanation could be found for these provocative results.” Our findings suggest an explanation: Prehospital vital signs are highly variable, and even more so for the sickest patients. Gradual changes in vital signs caused by progressive pathologies, (e.g., hemorrhage) are too weak to be diagnostically useful.

Moreover, our findings are consistent with the findings of Shapiro and colleagues¹¹ and of Lipsky and colleagues,¹⁰ who independently reported that, among patients who arrived normotensive in the emergency department, one or more episodes of preceding hypotension were associated with higher acuity (Shapiro et al., studied air ambulance patients and used hypotension as a predictor of mortality, and Lipsky et al. studied ground transport patients and used hypotension as a predictor of emergent surgical intervention). If there are no major temporal trends during prehospital transport (as we report here), then measurements made at the end of transport are not more useful than preceding prehospital measurements. Though we did not find any gradual progressive trends, we found that our higher-acuity cases had lower average SBP and wider SBP fluctuations, which, in practice, meant that our high-acuity patients were prone to nonsustained episodes of frank hypotension, consistent with the re-

ports of Shapiro et al., and Lipsky et al. Taken together, our findings, along with the reports of Morris et al., Shapiro et al., and Lipsky et al., suggest that prehospital vital sign variability is characteristic of high-acuity patients in myriad prehospital arenas. Our findings, together with what was reported by Morris et al., suggest that gradual progressive trends may be too weak to be of diagnostic value.

Of course, it is inevitable that major uncontrolled hemorrhage will ultimately cause a decrease in SBP. For that reason, we expect that in our data set there are probably real, but weak, differences in vital sign trends between major hemorrhage and controls. In one sensitivity analysis (in which we studied the largest possible population without any subject exclusions on the basis of their vital sign reliability), we did find that 28% of hemorrhage cases had a reduction in SBP after 2 minutes, compared with only 10% of the control cases. However, this association, even if not an artifact of repeated statistical testing, would be neither sensitive nor specific as a diagnostic tool, and it does not challenge our consistent finding that, given just 21 minutes of data in a highly uncontrolled prehospital air-ambulance environment, temporal trends in vital signs do not appear to be diagnostically useful. The up-and-down fluctuations in the vital signs appear to mask any gradual temporal trends.

LIMITATIONS

There are likely factors that weakened the discriminatory value of early temporal trends within this data set. Prehospital interventions may have “stabilized” patients (e.g., putting pressure on external bleeding, giving intravenous fluid and supplemental oxygen before or during air ambulance transportation) and so reduced temporal trends over the 21 minutes. To reduce the effects of “physiologic noise” (episodic physiologic changes due to moments of pain, fear, etc.), it may help to make additional measurements that account for the sources of physiologic variability. It is conceivable that additional information about analgesia, movement, agitation, fluid boluses, etc., might improve the discriminatory value of vital sign trends, if incorporated together in a multivariate predictive model. (We do not think that prehospital intravenous fluid administration was a major factor, however. In a prior analysis of these data, we developed a multivariate regression model to predict major hemorrhage.³¹ We found that inputting the volume of fluid as a predictor of hemorrhage did not significantly add new information; i.e., it did not improve the multivariate classifier over and above the vital signs.)

In terms of our analytic methodology, the use of automated algorithms to identify reliable vital signs is a potential limitation, because if the algorithms are inaccurate, they may accept erroneous data and confound our results. The validity of these algorithms was reviewed in detail in the Methods section. This automated methodology was advantageous for several reasons. It enabled us to run, methodically, through a set of sensitivity analyses, in which we alternatively tightened and relaxed the reliability criteria for the vital sign data that we analyzed. In all permutations of our computations, we always found the same results, which reinforced our primary findings. Note that stringently selecting patients based on data reliability was a double-edged sword:

it increased the reliability of the vital sign data that were included, but it also reduced the available data for analysis. In our primary analysis, a large number of the patients in the database were excluded because of insufficient data quality and quantity. This reduced the study's power to detect subtle differences in vital sign trends. For this reason, it was important to run those secondary analyses, in which we loosened the criteria, and we even performed one set of analyses without any restrictions on data quality. Such varied analyses are not possible if one examines only the vital signs documented by caregivers, and vital signs that are directly measured and documented by caregivers have been shown to be quite imperfect.^{15–18}

Perhaps hemodynamic deterioration occurs in abrupt transitions rather than in a steady fashion. Indeed, during the first hour after hemorrhage, transcapillary fluid shifts of up to 1 or 2 liters can occur,³² counteracting slow hemorrhagic volume loss. Certain neurohumeral compensations are also activated during this time frame. Such physiologic compensations may (temporarily) counteract the progressive effects of traumatic pathology during prehospital transport, stabilizing early vital signs. Our negative results may not apply to longer temporal windows and other more controlled clinical settings. Indeed, trend-based monitoring has shown at least some mixed value in the ICU setting, where there is less measurement noise and longer observation intervals.^{6–8}

CONCLUSIONS

Our findings add to a growing body of evidence that prehospital vital sign trends over 21 minutes or less are unlikely to be diagnostically useful. We found that nondirectional, up-and-down fluctuations in vital signs obscured any subtle, progressive temporal trends during air-ambulance transport. These substantial fluctuations were observed even when we analyzed the cleanest, most reliable physiologic data within each patient record, (e.g., ECG segments without motion artifact) which suggests that the variability is in large part physiologic. Measures that account for variability through time, such as taking the average of serial measurements rather than relying only on the initial measurements, may offer some improvements in the discriminatory value of prehospital vital signs.

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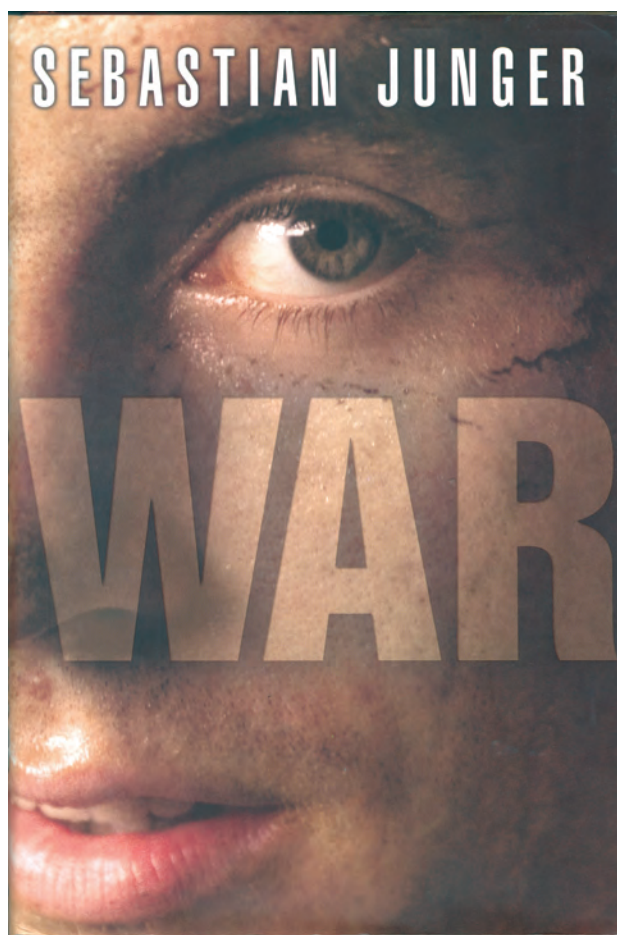


Book Review

War

Sebastian Junger. New York: Hachette Book Group. 2010. ISBN: 978-0-446-55624-8.

Review by LTC Craig A. Myatt



Sebastian Junger's *War* is a contemporary non-fictional story about combat and tough soldiering on tough terrain. The unit highlighted is Battle Company, "Rock" Battalion" (2nd Battalion, 503rd Infantry Regiment), 173rd Airborne Brigade Combat Team. Captain David Kearney, United States Army, commands the company in Afghanistan's Korengal Valley, which borders Pakistan. The six-mile long valley serves as a haven for Taliban forces moving in and out of Pakistan. It is the

same valley where U.S. Navy SEAL Marcus Luttrell and teams of Special Operations Forces engaged in high-risk missions in the spring and summer of 2005. Two years later, in the spring of 2007, Battle Company arrives to occupy and fortify an outpost that served as a base of operations for fiercely intense combat against Taliban forces and Afghan insurgents.

During Battle Company's Afghanistan tour, Soldiers in the unit named their command post Restrepo in memory of one of their fallen combat medics. Battle Company fought hard throughout its combat rotation with only sporadic lulls in enemy contact. Intense fighting took place in the Korengal Valley as well as in the neighboring Waygal Valley. Junger reports that in 2008, weeks shy of Battle Company's battle handoff and redeployment, sister unit Chosen Company, in the Waygal, engaged in the costliest firefight since the Battle of Mogadishu, with nine Americans killed and 27 wounded. Embedded in the unit and attentive to the physical and psychological demands faced daily by Battle Company Soldiers, Junger details the company's courage and exploits in three parts: Book One, "Fear"; Book Two, "Killing"; and Book Three, "Love".

Junger uses his journalistic perspectives to witness and interpret realities of war from a Soldier's mindset. The Korengal Valley becomes an effective proving ground to test one's individual grasp and recognition of fear, attitudes on killing, and transcendental knowledge of love. He creatively explores the mechanics of fear, killing, and love. He uses the mechanics of each to develop a theme on war that depicts the realities of young warriors in battle.

Junger observes, up-close, his own sense of fear. He also notices how the well-trained Soldiers in Battle Company perform in combat as a cohesive unit with a measure of psychological engagement that does not dismiss fear, but does not succumb to it either. Junger identifies in his book the biological components of fear. He even describes neurologic function in the amygdala and

cortex associated with reactions versus modulated responses that can distinguish the less disciplined Soldier from the elite Soldier in a cohesive unit.

Witnessing combat first-hand in the Korengal Valley with the Soldiers of Battle Company, Junger is enthralled by behaviors he observes in men who kill their adversaries in order to avoid being killed. Junger questions what drives a Soldier to kill in war. He presents answers that lead again to the dynamics of the unit.

Junger uses written notes and video recordings to observe the unit in combat. He notices that Soldiers appear better capable of meeting immediate and long-standing battlefield demands when they serve as well-attuned, highly trained and practiced professionals in cohesive units. He interestingly inserts discussion on biological and social theory, as well as short vignettes from previous wars, to support his observations. The factors that drive a Soldier to kill are individual, behavioral, and social.

Junger pushes himself intellectually, emotionally, and physically in the Korengal Valley. He learns first-hand how to survive in combat from hardened U.S. Soldiers. He reports his observations objectively. In good journalistic fashion, he provides relevant anthropological phenomena on combat, surviving it, and then returning to society where different norms and expectations govern survival and success.

Without losing journalistic objectivity, Junger directs discussion in his text to “love.” Junger describes love as the mechanism that allows well-trained Soldiers to transcend to a higher level of existence in order to survive in war. Each warrior, in his own way, is challenged

to apply outcomes of that mechanism in his transition from war back to society.

Though Junger objectively presents the topic of love, he somewhat awkwardly constrains his discussion of it. The template of his dialogue is not universal, historically patriotic, or Biblical. It stems from what appears to be his ethic of love and his journalistic determination to remain objective.

In the Korengal Valley, Junger observes through his young comrades in arms that the most outspoken discussion of love focuses simply on one warrior’s respect and admiration for another. Unit cohesion in war fosters a unique love for others. The friendships galvanized in war validate that. Junger guides his reader toward understanding how the warrior who uses the best of his military training to survive in battle remains a warrior beyond the aftermath of war. His closing observations suggest that the transcendent mechanism elevating a warrior’s ability to cope in war, and in transition from combat to society, forms a lasting bond of brotherhood.

That bond does not extend to society, but society can appreciate it. It is a unique and hard-earned love. In the end, Junger challenges his readers to appreciate how the balance between a warrior’s ability to transition from war to society and society’s ability to receive its returning warriors is achieved, in all its complexity, by meeting basic physical and psychological needs that promote value and love for the warrior in society. Junger offers keen insights into the warrior mind-set and American social responses to war. Those insights are meaningful to any reader committed to serving the needs of U.S. military Servicemembers.



From the Command Surgeon



Virgil "Tom" Deal, MD
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Greeting to all from Tampa. First of all, our thanks go out to all for the hard work and dedication to the missions at hand and to providing the best medical care in the field and in garrison to the SOCOM community. At the heart of SOF medical doctrine and training since its opening has been the Joint Special Operations Medical Training Center (JSOMTC). Last month the colors of the Command of the Medical Training Group passed between two of our best — from COL Jeff Kingsbury to COL Rob Lutz. Our thanks certainly go with COL Kingsbury for the incredible job he has done in maintaining the quality of instruction in a time of significantly increased demand for more SOF medics for the force. Please join me in welcoming the new Dean of the schoolhouse and Commander, Medical Training Group, COL Lutz. As there are not many SOCOM units that Rob hasn't either ably served or served in, there is no doubt the standards of excellence at the JSOMTC will be well maintained. Jeff and Rob — thanks and best wishes to you both!

The last few months have seen a great deal of activity in support of the SOF warrior in the field. No area of endeavor better highlights the unique challenges of medical and surgical support in the SOF AORs than the emerging discussions regarding damage control re-

suscitation (DCR). The tactical scenario in which I think about the principles of DCRs would be best applied could perhaps be described as "what you do when the MEDEVAC bird is actually a CASEVAC yak or water buffalo and it's going to be three days to the nearest capability for surgical intervention by whatever means." Before we began talking about low volume resuscitation, such discussions would have been at least counter-current to the mainstream of thought on getting the critically wounded or injured as quickly as possible to the nearest surgeon for damage control surgery if not definitive surgical care. With the emergence of low volume resuscitation and other tools for controlling blood loss, we're now working with our friends in industry and research to find newer and better means for the control of compressible and non-compressible hemorrhage when a one hour evac to a well appointed operating room isn't an option. R&D possibilities on the horizon include freeze-dried plasma, possibly instead of or after Hextend, as well as other agents to locally activate the clotting mechanism. We'll be tracking to get the right tools in the right hands as soon as possible. Central to all these efforts, of course, is your feedback to us for what each of you feel is most needed ... keep the cards, letters, and emails coming!



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USASOC



The current year has seen a sentinel change in the engagement and operations of Army Special Operations Forces (ARSOF) in Afghanistan and around the world. The ongoing “surge” in Operation Enduring Freedom has placed a renewed emphasis on Counterinsurgency Operations (COIN) within the Coalition strategy. Decentralized, population-centric and partnership driven operations has been and will always be a core competency of ARSOF, a key element of which is medical operations. One of the greatest elements that preserve our Commanders’ ability to prosecute a COIN strategy is the excellence of our ARSOF medical personnel. The ability of our Special Forces, Ranger, Special Operations Aviation Regiment (SOAR), Civil Affairs (CA), and Military Information Support Operations Group (MISOG) medics to support ARSOF Soldiers in a global strategy — simultaneously encompassing direct combat operations, foreign internal defense and non-kinetic humanitarian engagement — speaks to the pre-eminence of U.S. Army Special Operations Command’s (USASOC’s) enlisted medical providers. Providing world-class casualty care and supporting humanitarian/civic medical, veterinary, and dental engagement in the austere, forward environment, makes USASOC’s medical capability unmatched for flexibility and relevance in the DoD strategy — now and for the foreseeable future. The next few years will certainly provide a refinement in the focus of the National

Defense Strategy. I feel certain that ARSOF will remain the lead element in COIN, Unconventional Warfare (UW), and Foreign Internal Defense (FID) engagement around the world — and our medical excellence will be a key skill in enabling our Commanders to meet the mission — in both kinetic and non-kinetic operations.

Maintaining “the edge” in our medical capability is critical to sustaining our forces and our relevance in the DoD. USASOC must continue to refine and update its training courses and programs of instruction — fed by feedback from the field and inculcating emerging technologies and new clinical techniques. USASOC is examining the incorporation of more operations training into medic courses, advances in hemostatics, the applicability of ultrasound, advances in medical simulations, and advanced level medical courses among other ideas. The driver behind many of these ideas is input from Soldiers. MSG Ware and I had an excellent fact finding “walkabout” in Afghanistan late this spring and received excellent, well reasoned, “no bull” input from every level — from the medic to the senior medical officer. The DCS, Surgeon’s Office exists to push medical issues within the USASOC Staff and to the Commanding General. To keep courses and equipment sets relevant and to “read the tea leaves” in producing medics for the future strategy — we need your input. Keep us on our game and keep feeding us the ground truth on medical operations and requirements at the sharp end.

Keep doing what you do — you’re the best in the world. Sine Pari.

COMPONENT SURGEON



Bart Iddins, MD
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The preceding seven articles addressed Air Force Special Operations Command (AFSOC) Surgeon's Priorities 1 through 7 (see *JSOM* Winter 2009 edition for complete priority list. For detailed reviews of Priorities 1 through 3, refer to *JSOM*'s Spring 2009 edition; Summer 2009 edition for Priority 4; Fall 2009 edition for Priority 5; Winter 2010 edition for Priority 6; Summer 2010 edition for Priority 7). This article discusses the remaining three priorities:

Priority 8: Improve tour stability for AFSOC enlisted medics

Priority 9: Forward-base AFSOC surgical and critical care evacuation assets

Priority 10: Conduct critical assessment of all AFSOC medical capabilities, programs, philosophies, and paradigms

Each U.S. Special Operations Command (US-SOCOM) service component invests a significant amount of resources into its enlisted medical force; however, unlike the other components, AFSOC does not have a formal mechanism to ensure its highly trained medics serve more than one duty tour with AFSOC. Although, many AFSOC medics do serve multiple Special Operations Forces (SOF) duty tours, no mechanism is in place that ensures this outcome. As a result, AFSOC invests an enormous amount of time and financial resources into medics who may or may not serve multiple AFSOC tours. This represents a poor business practice, especially when one considers the return on investment. To address this concern, AFSOC Surgeon staff — most notably CMSgt Scott James and SMSgt Steve Cum — have worked tirelessly to improve tour stability for AFSOC enlisted medics. Progress has been made and

AFSOC



the process is well under way to standardize and lengthen tours for AFSOC's enlisted medics; nonetheless, the ultimate goal of establishing policy mechanisms in this regard remains forthcoming. Efforts will continue in this vein until this important goal is achieved.

Whereas the eighth priority has thus far met with partial success, the ninth priority, *Forward-base AFSOC surgical and critical care evacuation assets*, has been resoundingly successful. One AFSOC Special Operations Surgical Team (SOST) and one Special Operations Critical Care Transport Team (SOCCET) are now assigned to the 352d Special Operations Group in direct support of Special Operations Command Europe. These teams are embedded with Landstuhl Regional Medical Center in order to maintain clinical currency. Additionally, in order to achieve improved clinical currency, one SOST/SOCCET is embedded with Saint Louis University Medical Center and one SOST/SOCCET is embedded with the University of Alabama-Birmingham Medical Center.

Where clinical currency and proficiency of skills were not achievable with three to five SOST/SOCCETs assigned and concentrated at Hurlburt Field, Florida, this new and unique basing strategy ensures SOST/SOCCET personnel are clinically current, consistently perform at the top of their surgical/critical care game and are always ready for deployment operations. In addition, this basing strategy allows for SOST/SOCCET personnel assignment rotations that were not possible when AFSOC's SOST/SOCCETs were assigned exclusively to Hurlburt Field.

Perhaps the most difficult priority to achieve is the final one, *Conduct critical assessment of all AFSOC medical capabilities, programs, philosophies, and paradigms*, since it involves possible change to the status

quo. Organizational bureaucracies typically resist change in favor of preserving the status quo. However, SOF cannot afford to let bureaucratic inertia prevent the adoption of evolutionary and revolutionary processes; organizational structures; command and control schemes; doctrine; tactics, techniques, procedures, technology, etc. SOF medical organizations must innovate, evolve, change, and adapt in order to remain relevant. We must deliberately and aggressively work to increase both efficiency and effectiveness. The realities of massive federal budget deficits and the ballooning federal debt portend cuts in discretionary federal spending and almost certainly, cuts to future DoD budgets. It seems inconceivable that the DoD can indefinitely sustain \$50.7 billion in healthcare costs; therefore, we must guarantee that SOF medical organizations match their unprecedented effectiveness with an equal level of efficiency. In anticipation of flat resource levels (at best), or declining resource levels (at worst), AFSOC's medical organization is pursuing efficiency with the same fervor that we have always pursued effectiveness, and in which both goals are viewed as mutually inclusive. Consequently, the AFSOC Surgeon staff is in the midst of a deliberate critical review of all AFSOC medical processes, policies, programs, and activities. Nothing is considered sacred or

off-limits. This critical review process will by necessity remain ongoing and open-ended; otherwise the organization risks stagnation. Significant increases in efficiency and effectiveness have already been realized; for instance, AFSOC recently established the Air Force's first-and-only Irregular Warfare/Medical Stability Operations Division. It now leverages in-garrison medical assets, Air Force Reserve/Air National Guard assets, and operational medical assets in order to build a fully interoperable medical system. This system shifts seamlessly between in-garrison medical support, to combat medical support, to medics as a non-kinetic weapons system in a supported role conducting Irregular Warfare and Medical Stability Operations. It is a concept designed to efficiently utilize all resources and has already proven extraordinarily effective as was dramatically demonstrated by AFSOC's response to the January 2010 catastrophic Haiti earthquake. Within 24 hours, AFSOC responded immediately and decisively with full-spectrum lifesaving medical capability. It simultaneously conducted in-garrison and warzone combat medical support ops, as well as medical stability operations in support of Theater Special Operations Commands.

In conclusion, AFSOC Surgeon's priorities can be distilled down to one axiom, "Adapt or Perish!"



COMPONENT SURGEON



Anthony M. Griffay, MD
CAPT, USN
Command Surgeon

In a true Navy fashion Marine Special Operations Command (MARSOC) continues to steam ahead while periodically turning into the wind to launch and recover a team, company, or a Special Operations Task Force (SOTF) as we go. The thousands of independent parts and people it takes to perform this function are starting to gel and the processes are being perfected and improved. At the Headquarters Health Service Support (HSS) we are doing the same, steaming ahead with the everyday plans and policies that keep the component moving while continuing to turn into the wind to develop something new.

Over the last quarter HSS has reorganized to incorporate some capabilities from both within MARSOC and from Special Operations Command (SOCOM) as well. We have moved the functions of the command psychology section, the environmental health officer, the medical logistics officer, and the preventive medicine section in to the HQ HSS. We have also been funded by SOCOM for a Special Operations Forces (SOF) care coordinator and a family and marriage counselor to join us. These new capabilities combine with some new policies and allow us to multi-task to a much broader degree than anything we have done in the past.

Currently we are developing and writing several policies which when completed will help move MARSOC towards a new direction in caring for our members. First is a policy which uses every level, from the teams to SOCOM and the Care Coalition, for tracking wounded warriors from injury through the remainder of their lives. Second is a Medical De-briefing Policy, which develops a more consistent de-briefing format focused on medical

MARSOC



lessons learned and allow us to better adjust medical standard operating procedures (SOPs) and develop better tactics, techniques, and procedures (TTPs) across the MARSOC mission spectrum. Third is the Area Surveillance Policy, which is the first step in a larger medical augmentation plan, which will increase the ability of MARSOC to supplement deployed units with medical subject matter assistance teams with environmental, preventative, veterinarian, and dental capabilities. It is envisioned that as manpower requirements are filled we will apply the same policy to medical, surgical, humanitarian, disaster, and woman's health assistance teams as well.

The fourth policy currently being launched is called the Human Factors Policy and is a far reaching and broadly defined policy, which when done, will encompass all of MARSOC. In general the policy is an operational strategy which will utilize all the very impressive capabilities within MARSOC to fight the destructive effects of stress on our fighting force. Whether from injury, combat, deployment, financial, or family, stress affects us all: it is a normal part of anyone's life. Stress can be good and, if handled correctly, is what makes us better; but it can also be harmful and destructive if it overwhelms one's own internal defenses. This policy will focus on how MARSOC command, staff, and subject matter experts will work together to increase personal resilience to stress and recognize harmful stress events or symptoms. Then, in a coordinated, effective, and confidential manner, they will work to assist any member with managing and growing from their stressful event. The entire MARSOC organization will have a policy to gain from post-traumatic growth by working together to save

lives, manage careers, and develop families. SOF is a hard, dangerous, time demanding life and stress is just another enemy that can be defeated with the proper plan-

ning and teamwork. The Human Factor Policy will manage stress to grow careers, not let it end them.

As always, please feel free to contact me at any time, Anthony.griffay@usmc.mil.





SOC PAC



Frank J. Newton, MD
COL USA
Command Surgeon



The New and Necessary Role for the TSOC Surgeon

COL Frank Newton, LTC Brady Reed

In this column, my deputy, LTC Brady Reed, will share some of his insights in working with our PACOM J07 and its components on the concept of a Theater Health Engagement Strategy. The TSOC surgeon has the opportunity to bridge the gap between SOF's operational needs and the medical engagement plan executed by general purpose forces. We add value through our persistent presence of working by, with, and through partner nations over a sustained period of time.

United States Special Operations Forces (SOF) remains actively engaged in Joint Combined Exchange Training (JCET) with partner nations in an effort to build self-reliant capacity and enable those partners to defeat terrorism. One non-lethal dimension to SOF, which is a key component of Irregular Warfare, is soft power defined by Joseph Nye, Jr., Former Dean of the Kennedy School of Government, as "getting others to want the outcomes that you want" (other than through coercion). This use of soft power is designed to address civil vulnerabilities and develop strategies to mitigate against terrorist recruitment. Soft power is often employed in episodic medical, dental, and/or, veterinary civic actions programs (MEDCAPs, DENCAPs, and VETCAPs) in an effort to "win hearts and minds." The problem herein is that they typically are tied to measures of productivity (how many), instead of measures of effectiveness (how well – or how good – the result). The problem exists both in SOF and general-purpose (GP) forces' engagements.¹

COL Frank Newton, the Special Operations Command, Pacific (SOC PAC) Surgeon and MAJ Shawn Alderman, 2nd Bn, 1st SFG (A) Surgeon, recently wrote in the *JSOM* about the need for a different model. However, these thoughts are not limited just to SOF. Col Sean Murphy, the Pacific Air Forces (PACAF) Surgeon said the U.S. Agency for International Development (USAID) Civil-Military Health Strategy cites the short-comings of the traditional MEDCAP model and espouses what Murphy calls "cooperative health engagement (CHE)." He believes that "building partner capacity (BPC)" has an egocentric ring to it which may offend some foreign leaders with whom we are trying to engage.² This is worth considering since BPC is an integral objective of many SOF plans. The bottom line is that we *can* dispose of acute (episodic) engagement and still meet operational needs. Putting this together should be a key role for the Theater Special Operations Command (TSOC) surgeon's office (TSOC SO).

It is precisely in the *where* and *how* to engage that the TSOC SO can help. First, each geographic combatant command (GCC) needs a theatre medical or "cooperative" health engagement strategy. Without one, the various Department of Defense (DoD) and interagency partner activities will continue the status quo of conducting "random acts of kindness." The TSOC surgeon can help shape the GCC's health engagement strategy so that it addresses SOF operational priorities as well as those of the partner nation and

other U.S. government actors. It does this by leveraging the assets of SOF, augmentation teams, civil-military support elements (CMSEs), and JCET teams, to identify populations at greatest risk for terrorist recruitment.

Second, the TSOC surgeon and civil affairs (CA) officer can create a combined medical and non-medical civic projects development plan. Using a cooperative health engagement model, the medical requirements could then be coordinated through the GCC and executed by the GCC's components. An example of how unity of effort could make a better impact follows: The TSOC may identify a series of provinces or villages whereby developing some medical capability is in-line with the partner nation's desires while also serving SOF operational requirements. The GCC components could be coordinated such that an Army element conducts a CHE in Village A, while a USAF element conducts a parallel CHE in Village B. Projects could be coordinated in serial fashion such that in Village A, a Marine element teaches (and *learns*) local medical disease surveillance and a USN element follows some time later to exchange preventive medicine practices. It is also worth considering the value of linking such engagements to projects in the same locations that are targeted for improvements or new construction such as wells, roads, or schools. Once these villages demonstrate self-sufficiency, the military teams move on to another area.

Finally, the work of other organizations can and should be harnessed around a shared purpose. To the great

est extent possible, they should be made an integral part of the overall CHE effort. The USAID, the Center for Disaster Medicine and Humanitarian Assistance Medicine (CDHAM), the Defense Institute for Medical Operations (DIMO), and Defense Medical Readiness & Training Institute (DMRTI) are all valuable stakeholders in the GCC's Area of Responsibility (AOR). An additional agency operating in the PACOM AOR is the Center of Excellence, which specializes in disaster relief and humanitarian assistance.

In summary, the TSOC surgeon's office provides the commander with another asset (soft power), to achieve his objectives. It is in a unique position to shape both GCC medical strategy and specific engagement design working by, with, and through the respective GCC surgeons, fellow MACOM component surgeons, and others like USAID. Finally, the TSOC surgeon's office must plan and execute with sensitivity and discretion to find areas where different objectives of the stakeholders can be met through cooperative health engagement.

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TSOC SURGEON



Ricardo Ong, MD
LTC USA
Command Surgeon



SOCAFRICA



We are in full swing on the African continent. Flintlock 2010 was successfully executed in Burkina Faso and Mali this past Spring, and we're already planning for 2011. OEF-TS (Trans-Sahara) and SOCCE-HOA (Horn of Africa) remain our primary engagements, as we have several hundred individual spread out across these regions.

Operations in this AOR are heavily oriented towards partner nation engagement, in which we play a significant role. In this capacity, we contribute on two main fronts. First, we provide basic combat medical field training (TC3, CLS, First Aid, etc); the level of training depends on the particular mission and troops we happen to be training. Second, we will augment the numerous Med/Dent/Vet CAP activities conducted at the ODA or CA level. We've had many successful operations, with many more planned. I'd like to extend my appreciation to the AFSOC Irregular Warfare medical program, which has been our primary sourcing solution for many of these missions, several on very short notice. The program that BG Iddins has developed is flexible and well resourced; I hope that this program can serve as a model for the other services if interested in enhancing medical engagement and irregular warfare capacity.

As most of my counterparts at the other TSOCs know, I've been searching for a solution to the civilian medical support issue, including both medical care on and MEDEVAC from the African continent. Several temporary and partial solutions are currently being used

by other TSOCs, but I'm still not satisfied. I'm currently engaged with International SOS (ISOS) to try to establish a service contract directly with SOCAFRICA to provide the same services that our active duty servicemembers receive. This would include guarantee of payment up front to local medical facilities, as well as MEDEVAC services off the continent. I believe that this will be the best and most comprehensive solution if I can establish this service contract.

I am also looking at establishing a long-term contract with an air service on the continent to bridge the gap between point of injury and damage control care. This remains the big gap in our medical support plan, as we are still challenged to get from extreme remote locations to any level of medical care. I hope to have a reasonable plan to report soon.

Finally, I'm in the last stages of gaining access to two different medical databases in which I am greatly interested: Department of State (DoS) and ISOS. The memorandum of agreements (MOAs) with DoS are awaiting final signatures, then I should have access to their medical database. TRICARE Europe has modified their current contract with ISOS to allow access to their database, so I currently have a request for information in to test this system. I'm hoping that access to both these databases will enhance our ability to plan adequately for future engagements.

Aside from all this, Africa is still hot, it's still big, and there's still plenty of useful work to do.

Special Forces Surgeon



LTC Andrew Landers, MD
COL, USA
Command Surgeon



USASFC



Summer greetings from sunny Fort Bragg, NC. Along with the heat comes the ever increasing need for Special Forces in this global conflict. We must keep medically up to date to meet these ever increasing needs. MSG Rick Hines has officially come on board as the Senior Enlisted Medical Advisor. His contact info is hinesr@ahqb.soc.mil; office number is 910-432-6577. Make sure that you update your contact rosters after the smoke clears from the summer transitions.

The Tactical Ultrasound Program continues to gain steam. The first round of ultrasounds have been delivered and we anticipate that all the Groups will receive their machines by this September. Again, I cannot stress enough the importance of training in order to gain the full benefit of this new equipment. CPT Bill Vasios is on board as the Regimental PA and is in charge of the Ultrasound Program. Please feel free to contact him to set up training. His contact info is william.vasios@ahqb.soc.mil. We are also working on a complete ultrasound training program and protocols that will be put out over the next six months. There will be a one day training seminar at SOMA as part of the ARSOF Medic Conference.

As fall and winter approach, two important training events will occur: 1) SOMIC (Special Operations Medical Indoctrination Course) will be held 20-24 September. This is a great opportunity for all the new ARSOF medical provider to get a good overview of SOF and how things work. I encourage all members to take advantage of this course. 2) ARSOF Medic Conference on 11-12 December followed by SOMA on 13-16 December in Tampa. Don't forget to make your reservations early. We have a vast array of topics and "hands on" training during the ARSOF medic conference. It should be a learning experience for all that participates. Look forward to seeing you there.

I want to close by thanking everyone for what you do on a daily basis. We have the greatest job in the world to be able to serve with and care for Special Operations Soldiers and their families. Continue to stay focused on the task at hand and remember to send in your lessons learned. We must adapt with the ever changing environment and stay medically up to date. De Oppresso Liber!

USSOCOM Psychology



LTC Craig A. Myatt, PhD
HQ USSOCOM Psychologist

Commentary on Psychology Capability Support and Resilience

The expanding role of psychology capability support in the Department of Defense (DoD) is improving the capacity to deliver organizational services offered through the Military Health System (MHS) and in conjunction with it. The MHS typically provides behavioral healthcare and certain deployment healthcare support through medical treatment facilities (MTFs) such as hospitals, satellite clinics, and combat stress units. Psychologists in Special Operations Forces (SOF) units provide organizational support to SOF personnel. The function of their support in what is a non-clinical setting offers proactive organizational services that utilize their expertise in the behavioral sciences prior to any psychological insult that would require personnel referral to MHS services. That proactive organizational support is being extended to families. The expanding multi-disciplinary and multi-functional role of psychologists in the DoD enhances the capacity for expanded psychology capability support throughout U.S. Special Operations Command (USSOCOM).

By leveraging DoD and the Services for resourcing support, our component psychologists at U.S. Army Special Operations Command (USASOC), Naval Special Warfare Command (NSWCOM), Air Force Special Operations Command (AFSOC), and U.S. Marine Corps Forces Special Operations Command (MARSOC) will continue to benefit from the expansion of DoD psychology capability support. On 21 July 2010, the Special Operations Command Requirements Evaluation Board (SOCREB) validated the SOF Resilience Enterprise Program (SOF REP). The validation provides the HQ USSOCOM with a program of record to leverage DoD resourcing for additional psychology capability support.

The SOF Human Capital Preservation Strategy remains our benchmark by all standards. As the SOF REP obtains resourcing to support its initial operating capability (IOC) requirements, the program is authorized now to fill the gap in HQ USSOCOM psychology capability support, innovative on-line training approaches, and Joint Special Operations University (JSOU) resilience education. Beyond what the Services already provide with deployment

health assessments and other assessments, such as the Global Assessment Tool used by the U.S. Army Comprehensive Soldier Fitness program, the SOF REP is targeting the formulation of “resilience” metrics useful to SOF personnel, first-line supervisors, commanders, and potentially family members.

By avoiding a redundancy of effort with pre-existing Services and component programs, the SOF REP will formulate the use of metrics that meet requirements across USSOCOM. The role of the Command Surgeon’s Office in that process is expanding to provide direct support to the component command psychologists and psychiatrists working independent of, and in conjunction with, each component command surgeon’s office. That role will continue as we move toward a desired end state for the SOF REP. The program end state is: enduring operational effectiveness in SOF and their families.

The methods employed to achieve the SOF REP end state include the use of metrics to assess and monitor operations tempo behavioral effects (OTBE). The use of a “resilience profile” and other applications in resilience currently underway at USASOC, NSWCOM, AFSOC, and MARSOC are all intended to promote hardiness and strengthen operational readiness in SOF personnel and their families as a means of minimizing disruptions in mission-focused operations and family life despite an increasing Operations Tempo (OPTEMPO).

Resilience is a biobehavioral factor that can be assessed operationally for continuous feedback through command channels. It is a subset of broader organizational characteristics that include leadership, education, training, and culture. The role of psychologists in any SOF organization is not limited to promoting resilience. The array of services and support that psychologists provide units and their leadership is expansive. Therefore, resilience presented in the context of the SOF REP remains as only one factor among many that supervisors and commanders can systematically review in preparation for time-sensitive mission execution.



SOF Human Capital Preservation

Components

- Small Unit Operations (SOF)
- Embedded Psychologists
- Civilian Psychologists
- Social Worker Augmentation

Services

- Military Health System
- Mental Health Clinics
- Defense Centers of Excellence
- Entry Level Training
- Professional Development
- Comprehensive Soldier Fitness
- Combat Operational Stress Control and First Aid
- Suicide Prevention
- Global Assessment Tool
- Life Skills Training
- Semper Fit
- Resilience Training
- Pre/Post Deployment Health Assessments
- Small Unit Excellence Training
- Mental Health Advisory Teams

Filling the GAP

- HQ Psychology Capability Support
- Modify On-line Training Modules
- JSOU Resilience Education
- Senior Enlisted Advisors Course
- Pre-Command Course

- Components**
- "Resilience" Metric
 - Sustain Combat Power
 - Enduring Operational Effectiveness
- Services**
- Innovations handover to Services

USSOCOM

- Doctrine and Policy
- Synchronized Component Capabilities and Capacities

End State

Metrics to Measure Resilience Profile

Tactical Combat Casualty Care February 2010



**Direct from the Battlefield: TCCC Lessons
Learned in Iraq and Afghanistan**



TCCC Lessons Learned in Iraq and Afghanistan

- Reports from Joint Theater Trauma System (JTTS) weekly Trauma Telecons
 - Every Thursday morning – worldwide telecon to discuss every serious casualty from that week
- Published medical reports
- Feedback from doctors, corpsmen, medics, and PJs



Train ALL Combatants in TCCC

- Potentially preventable deaths averaging about 20% of all fatalities
- Units that train all members in TCCC have drastically reduced this incidence
- **Need to train ALL combatants in TCCC**





Fatal Extremity Hemorrhage

This casualty was wounded by an RPG explosion and sustained a traumatic amputation of the right forearm at the mid-forearm level and a right leg wound. He bled to death from his leg wound despite the placement of three field-expedient tourniquets.

What could have saved him

C.A.T. Tourniquet

**TCCC training for all
unit members**

***Note: Medic killed at
onset of action**



Tourniquets

- **Get tourniquets on BEFORE onset of shock**
 - Mortality is very high if casualties already in shock before tourniquet application
- **If bleeding is not controlled and distal pulse not eliminated with first tourniquet – use a second one just proximal to first**
 - Increasing the tourniquet WIDTH with a second tourniquet controls bleeding more effectively and reduces complications





Tourniquet Case Report Afghanistan – Nov 2009

- Soldier with gunshot wound to left leg
- Open fracture left femur
- Injury to popliteal artery and vein
- Three CAT tourniquets placed
- Life saved
- Leg doing well
- **2-3 casualties/week being saved with tourniquets**



Tourniquets

- **Tighten velcro band on tourniquets as tight as possible before starting to use windlass – a loose velcro band contributes to tourniquet malfunction**
 - Should be effective with approximately three 180 degree turns of windlass
 - Use second tourniquet as needed





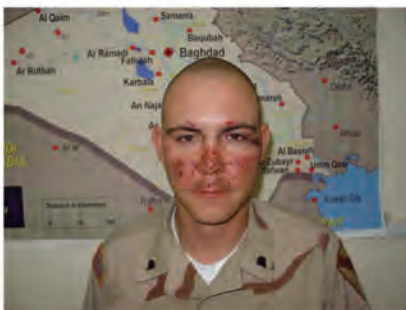
Tourniquets

- **Fake CAT tourniquets that are prone to malfunction are turning up in theater – ensure that you have this NSN tourniquet:**
- **NSN 6515-01-521-7976**

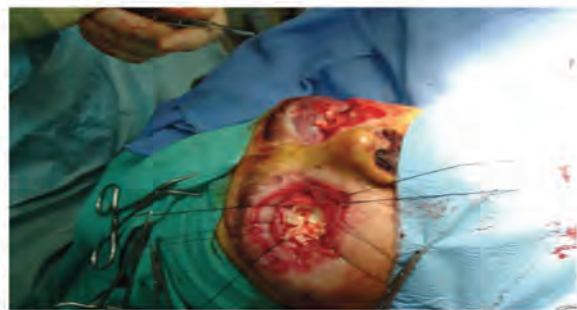


Wear Your Eye Protection!

- **Jan 2010**
- **22 y/o near IED without eye protection**
- **Now blind in both eyes**
- **Don't let this happen to you – see slides below**



With eye pro – eyes OK



Without eye pro – both eyes being removed



Penetrating Eye Trauma

- **Rigid eye shield for obvious or suspected eye wounds - often not being done – SHIELD AND SHIP!**
- **Not doing this may cause permanent loss of vision – use a shield for any injury in or around the eye**
- **Eye shields not always in IFAKs**



Shield after injury



No shield after injury



Eye Protection



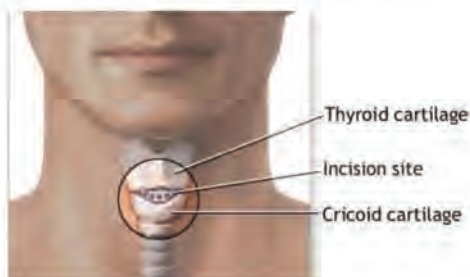
- **Use your tactical eyewear to cover the injured eye if you don't have a shield.**
- **Using tactical eyewear in the field will generally prevent the eye injury from happening in the first place!**



Surgical Airways

Joint Theater Trauma System Email 24 September 09

- 3 field crics done incorrectly in OIF
- One through center of thyroid cartilage and through one of the vocal cords



Surgical Airways: The Rest of the Story

“The setting of the casualty care was at night in a non-permissive environment. The medic had sustained a sacral injury and damaged his NVG's during a hard landing on infil. The casualty had sustained a gunshot wound to the jaw. The medic was not called to the scene for ten minutes due to an ongoing firefight. The jaw was shattered and he had heavy maxillofacial bleeding. The recovery position was attempted repeatedly, but the casualty refused to remain like that. Anxiolysis was attempted with Versed to facilitate maintaining the airway with position alone, but did not work. The casualty became increasingly combative and the decision was made to perform the cric out of fear of completely losing the airway during evacuation. Due to the fact that the medic's NVGs were damaged, an operator (former 18D with two successful prior combat cric's) attempted the procedure with assistance by the medic. By then all landmarks had disappeared due to soft tissue swelling of the neck. Although complications resulted from the procedure, a definitive airway was established under extremely difficult conditions and the casualty lived.



Surgical Airways

Recommendations:

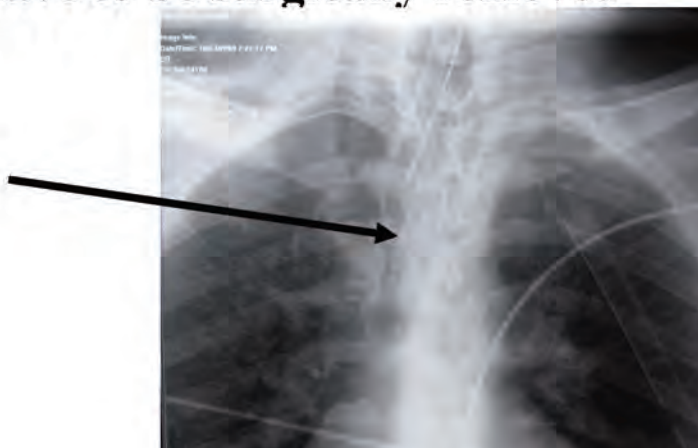
- Live tissue training for this procedure if possible
- “Sim Man” trainer may be second-best option
- Don’t attempt surgical airway just because the casualty is unconscious
- **Try the “sit-up and lean forward” position prior to attempting a surgical airway**



Surgical Airways

If you cut the endotracheal Tube, you must tape it very securely or the tube will slip down into the trachea, cease to function correctly, and have to be surgically removed

Like this one.....





IED Casualties

- **IED blast casualties often have multiple mechanisms of injury**
 - Blunt trauma
 - Penetrating trauma
 - Blast
 - Burns
- **Majority of casualties are now from IEDs**



IED Casualties

- **IED casualties – many have spinal fractures, especially thoracic**
- **Try to maintain spinal alignment in blunt trauma casualties**





IED Casualties

- **IED events – be alert for secondary IEDs or ground assaults after initiation of the IED**



Excerpts from the Tourniquet Working Group Members minutes of March 23, 2010

There were significant discussions among the group's participants stimulated by the combat medic presentations. One of the medics' presentations sparked a discussion regarding the locations of Combat Action Tourniquet (CAT™) breakages (mechanical failures), as well as IFAK (Improved First Aid Kit) supply issues (not enough tourniquets in the area of operations). Mr Lee from the U.S. Army Medical Materiel Agency (USAMMA) stated that he needed accurate documentation of the reported breakages. A COL stated that tourniquets are a onetime use item. After another medic's presentation, a discussion was held on the issue of exsanguinations due to traumatic injury. According to the COL, this seems to happen only once in every one to two hundred tourniquet applications. The last presenter, a non-medic Marine Corps Corporal (CPL), stated that only one tourniquet was issued to each Marine in his group. He felt a second tourniquet issued to the troops would be invaluable. This statement prompted further discussion by the entire group. Everyone in attendance agreed this was a valid recommendation. The COL stated that improved training could potentially correct the problem of tourniquets being incorrectly placed, and therefore found to be ineffective. When a tourniquet is ineffective because of improper placement, it should be removed and reapplied. A second tourniquet should be applied if the first (properly placed) tourniquet is ineffective.

Lt Col Hodge showed the various Service IFAKs issued to deploying members of the Marine Corps, Army, and Air Force. He then reported that the tourniquet market will continue to grow as manufacturers produce new tourniquets, not all of which are equal. Of late, there has been a disconnect on the "ground truth" of tourniquet fielding, supply, and what devices are actually in theater. Similar issues occurred with hemostatic agents regarding supply and actual fielding. Leadership listened when the hemostatic agent working group convened in June of 2009 to put Joint requirements and test parameters together for future work. Preventable deaths are still a problem, exacerbated by medical device breakage, life cycle, supply, and training variations. These are areas that may contribute to the problem. Procurement of devices has also been an issue. In previous years, all devices and technologies were "military standard" (MILSTD) driven in design and fielding. But now with commercial off-the-shelf (COTS) as the primary selection criteria, tracking an item becomes disjointed with the many different and independent databases having various sources.

Discussion and questions followed this portion of Lt Col Hodge's presentation, specifically regarding the counterfeit CAT model versus the regular CAT™, distributed by North American Rescue Products (NARP). Problems have arisen because both the counterfeit and the real devices have the same National Stock Number (NSN), and are outwardly extremely similar, despite significant differences in material composition. Discussion followed the statement by Senior Chief (HMCS) Casey requesting the number of breakages found within the 17 examined tourniquets. Lt Col Hodge replied that one or two tourniquets were broken, although buckling of parts was significantly more prevalent. It was asked if the users were double wrapping (running the tourniquet through twice, as they are instructed). Lt Col Hodge replied that at this time, they do not know the answer to that, but will look into checking that aspect in the future.

Lt Col Hodge then presented information on the Life Saving Initiatives (LSI) Study, which is currently at nine sites in Afghanistan and Iraq. The study fields surveys to medics on several medical devices. These surveys gather information on several facets of those devices, including outcomes, placement, and other issues. The LSI study is not examining the actual names of devices, but merely notes generic nomenclature. The study is tracking ten areas of equipment and care, including a) oral or nasal airway, b) endotracheal intubation, c) cricothyroidotomy, d) chest needle thoracostomy, e) chest tube thoracostomy, f) chest seal, g) wound packing with non-hemostatic dressing, h) wound packing with hemostatic dressing, i) tourniquet placement, and j) hypotensive resuscitation.

MSG Christopher Kosiorek from the Directorate of Combat and Doctrine Development (DCDD) presented a briefing on the importance of general capability requirements for equipment and specifically tourniquet requirements. He presented the background of tourniquet modernization going back to Somalia in 1993-1995, which showed that tourniquets were needed for combat-inflicted arterial bleeds. Tourniquets are now a part of basic medical training in the Army, and are integrated into the Soldier as a System (SaaS) program. The SaaS comprises everything worn, carried, or consumed by the Soldier. Specific requirements for Army tourniquets are that the device must be adequate for both upper and lower extremity application, it must have a windlass, and the Army recommends adding one-handed use as a threshold value to the capabilities required.

A discussion by the group followed MSG Kosiorek's presentation. One of the initial questions was if the companies were making tourniquets just for the military, or if there was significant demand in the civilian community. The COL responded that the civilian world is expanding its tourniquet use, but not as significantly as the military. He went on to explain that there are now many more contractors in theater, in addition to active duty troops. It is speculated that the current length of tourniquets is insufficient as there are many instances reported where the tourniquet was not long enough to go around a leg and be secured properly. The COL suggested that as far as length

is determined, the group should go to the 99th percentile of the Army's most recent anthropometric study, to accommodate the increased size of the average patient. Width of the tourniquet is an ever-present issue; the torque required for pressure applied changes directly in relation to the width of the tourniquet. (The wider the tourniquet, the less pressure is required to occlude the artery, but it will also require significantly more torque applied to the device to achieve that pressure.) Research shows the best median point at this time is 1.5 inches for the width of a tourniquet. The COL also pointed out that training must be device-specific to overcome differences with design and application of the various devices. Design and use are interlinked - narrow devices have breakage and inefficacy issues, while wider ones, if used improperly, can exacerbate nerve injury. One inch is a good minimum width, two inches is a good objective width, according to the science available at this time. MSG Kosiorek asked if two CATTMs in the IFAKs would be a good idea. The majority of those in attendance agreed that two tourniquets in the IFAKs would be ideal. Mr Lee stated that the multiple injuries (bi-laterally) to patients that are now prevalent can allow him to move toward issuing two tourniquets in the IFAKs without delay. Another COL stated that in his experience multiple extremity injuries are common, while among those, lower extremity injuries are most common. He also stated that two tourniquets on one extremity have been presented on more than one occasion. One case had six or seven tourniquets on one patient; while this was "a rare occurrence, it was entirely feasible." HMCS stated that the Marine Corps has recently changed their Statement of Need to include two tourniquets in the IFAK.

Lt Col Hodge then opened the round-table discussion to agree on tourniquet requirements for the next generation of operational tourniquets. He passed around the counterfeit and real CATTM tourniquets for side-by-side visual inspection and examination by the attendees.

Tourniquet width was established based on previous discussion at: one and a half inch minimum width versus the torque required to generate sufficient pressure to occlude the artery. A COL reiterated that the width of the device as it is used, is important; the past one inch wide device was effective, the past one and a half inch wide device was more effective, ergo, with increased width, one has a greater margin of safety. One and a half inch was agreed upon to be the minimum accepted width for future use. A question was raised, "Does the two inch width cause application error?" The COL replied that, "Yes, with respect to applied force." Regardless of current essential characteristics (EC), he stated that the Institute for Surgical Research (ISR) will continue to evaluate emerging new techniques and breakthrough technologies in this arena.

Weight was the next factor discussed. It was asked if there is an ideal weight a tourniquet should meet. It was stated that compactness was of greater value than weight, per se. HMCS asserted that the Marine Corps has a requirement of less than two pounds for the entire IFAK. The representative from the FDA asked that if the military is buying extra, why there was a weight concern. The responses from various participants were that the items the military requires them to carry, and what they actually do carry, are often different; for example, many have additional items in their packs. Each time an additional item is added, it adds to the weight the Soldier must carry. Considering the impact of this on mission performance, the less weight added the better.

Size was then discussed; It was stated that lower-profile bags are in development, there is however, a need for a protective tourniquet casing for carrying tourniquets outside of the IFAKs. The question was raised if a bigger IFAK bag was needed. A Lt Col stated that the IFAK should be a smaller bag, and the tourniquets themselves put into a rugged enough casing to supersede the IFAK bag.

Length was decided based on the 99th percentile of thigh circumference, measured at 28.1 inches. Added to that is draw space and enough length to accommodate the chassis apparatus. The consideration of exploded limbs with increased space/circumference, as well as excessively large individuals, was discussed. It was decided that 37.5 inches is sufficient for the population.

FDA approval was discussed next, as it is a standard Key Performance Parameter for medical devices. It was stated that the requirement must be specific; if the device must be FDA approved, it will need testing as well. A representative of the FDA explained that tourniquets are Class I devices and do not require clearance from FDA. This raised the question of tourniquets being re-classified to Class II devices. The FDA representative stated that the FDA can reconsider this, but Class II devices require additional controls. Class II devices require preclinical testing to ensure safety and efficacy for the intended use and population. The FDA stated that post-market analysis of failures reported (for any device, not just tourniquets and their like) is required in instances when failure rates reach a certain level. The FDA tracks these failures and does analyses on them to determine guidance and action accordingly.

One-handed application was discussed next by the group. It was stated via telecon that air Soldiers have a requirement for an embedded, uniform-integrated tourniquet. The primary argument for aviators is that pilots have different spatial and application needs. For pilots, if injured in a cockpit, a one-handed application solution is optimal. There was a response that while aviation may have a unique requirement, Dr Butler of the TCCC has said that the one-handed requirement will likely be phased out from the TCCC Guidelines. It was asserted that there has been a decreased percentage of self-application (close to 1%) of tourniquets. The conversation moved to the generalized issue of one-handed use standing as a requirement. It was stated that the exsanguinations speed issue has been ex-

amined, and those that would have benefited from such increased application speed were trapped-limb scenarios, which comprise a tiny proportion of the injured population. Requiring one-handed use would change a product's development, but not necessarily for the better: for example, the Emergency Medical Tourniquet (EMT), which is a "great device," although it cannot be applied with one hand. The initial requirement for one-handed use came from Special Operations.

The group decided that the manufacturer date and lot number should appear on the tourniquet to aid in life cycle determination when stored for long term.

Shelf life, specifically the issue of glue delamination and if the problem of degradation was due to environmental factors was discussed. It was stated that this was probably a temperature issue in first generations, but not in the newer ones. It was stated that the temperature extremes are realistic: -60 to +150F for storage, and -60 to +130 for operational use. It was stated that the group should add temperate, arctic, etc. nomenclature to the requirement to accommodate different climates in addition to temperature. It was stated that the Marine Corps has a rule to discard tourniquets after 30 days when their packaging has been opened. CDR Bleau responded that it falls on medical leadership to ensure that Line leaders understand the importance and ramifications of the medical gear issued to the warfighter.

Application time of a tourniquet was discussed. Application in less than 60 seconds has been the standard measure in the past. It was stated that the application time should be rational and reasonable. HMCS brought up the point that users must be fully trained in tourniquet application prior to assessing application time. It was stated that this facet can be written into the Statement of Work during test planning.

Maj Ritter introduced COL John Kragh of the ISR to present his briefing on tourniquets in pre-hospital use. COL Kragh reported on his studies of tourniquet use, including consideration factors such as looseness, placement on the limb, and one versus two tourniquets applied to a single limb. His prospective studies consisted of data received in the Baghdad emergency room. COL Kragh explained that limb occlusion pressure varies based on both limb circumference and tourniquet width. The use of tourniquets used to be binary – should we use tourniquets or not – but the current issue is no longer so simple. Despite more underlying bone, the lower portions of limbs have been shown recently to be paradoxically easier to occlude than the upper portions, and reflect the extent to which tourniquet knowledge has evolved.

The meeting concluded with a consensus of Joint tourniquet requirements and a foundation for Joint tourniquet test parameters.



Ranger First Responder and the Evolution of Tactical Combat Casualty Care

SFC Cesar Veliz, NREMT; MSG Harold Montgomery, BA, NREMT; LTC Russ Kotwal, MD, MPH

In 1996, the article titled *Tactical Combat Casualty Care in Special Operations* was published as a supplement to the Journal of Military Medicine, the official journal of the Association of Military Surgeons of the United States.¹ This article altered the course of pre-hospital combat medicine into what we know today as tactical medicine. The authors brought to the forefront the vast differences between providing pre-hospital trauma care in the civilian setting and providing pre-hospital trauma care at the point-of-injury on the battlefield. Using data collected from Vietnam, and more recent conflicts such as the Battle of Mogadishu, the authors presented an alternative solution to providing tactical pre-hospital trauma care at the point-of-injury within the military and the Special Operations community.^{2,3}

Military pre-hospital providers were not provided with treatment protocols and interventions that were relevant to the parameters of actual combat or tactical scenarios.^{4,5} What is best for mission success and what is best for the treatment of casualties may be in direct conflict, a quandary completely unique to combat or tactical medicine.

The three goals of Tactical Combat Casualty Care (TCCC) are to treat the casualty, prevent additional casualties, and complete the mission. These three goals combined mission tactics and medical care into recommended guidelines and protocols for a standard of care to be provided in the battlefield setting. The publication of the TCCC article in 1996, coupled with a Regimental Commanding Officer (COL Stanley McChrystal) directive for all Rangers to focus on four priorities in 1998, provided the necessary spark needed to refine the Combat Lifesaver (CLS) program and develop it into the Ranger First Responder (RFR) program of instruction in 1999. The RFR program continues and is updated regularly to reflect lessons learned during the conflict over the past decade as well as recommendations from the Committee on Tactical Combat Casualty Care and the U.S. Army Institute for Surgical Research.

The “Big Four” are the most important areas of command emphasis for all Rangers and are comprised of marksmanship, physical training, medical training, and small unit tactics. In 2006, the “Big Four” became the “Big Five,” when mobility was added to this list of priorities. The emphasis on medical training incorporated in the “Big Four” afforded the opportunity for medical personnel from the 75th Ranger Regiment to use the new TCCC guidelines and apply them to the CLS program, the Army standard at the time for non-medical “first-aid” care. TCCC guidelines and protocols focus on the care of casualties in a combat or tactical environment at the point-of-injury. RFR is a program of instruction that incorporates TCCC and better prepares non-medical Rangers to provide self-aid or buddy-aid in the absence of a medical provider. The RFR course uses a combination of didactic and hands-on instruction which culminate in an application of skills during scenario based trauma lanes. Although RFR has grown to include eight critical steps, the emphasis is still on the treatment of three preventable combat deaths; massive extremity hemorrhage, tension pneumothorax, and airway obstruction.^{2,6} The idea is that a Ranger doesn’t need to be able to perform surgery, but rather he should be a master of the basic treatment for these three medically preventable causes of death within the guidelines of TCCC.

The mastery of these critical skills can truly make a difference in the survivability of casualties on the battlefield. The number one medically preventable cause of combat death is hemorrhage from an extremity wound. Most casualties who have died on the battlefield have done so within minutes of being wounded.² Ranger First Responders are taught to immediately control bleeding and apply a tourniquet when confronted with massive arterial bleeding from an extremity wound. Controlling the bleeding first, with aggressive application of a tourniquet when needed, is in contrast to historical civilian medical protocols. Civilian protocols have traditionally taught managing the airway first and then moving on to breathing and circulation concerns. When presented with massive arterial bleeding, a secure airway is inconsequential if there is no blood left in the body to transport the oxygen being provided by a properly managed airway. Thus, controlling the bleeding first is a vital intervention that saves lives on the battlefield and as such is meticulously rehearsed and reinforced during RFR training.

After controlling the extremity bleed with a tourniquet, Rangers are taught to use hemostatic dressings and pressure dressings. Hemostatic dressings are impregnated with chemical agents that assist with the human body’s natural clotting factors. Along with the tourniquets and other medical supplies and equipment used by Rangers, hemostatic dressings continue to evolve and change as medical research improves and refines these medical technologies. The emphasis on controlling bleeding within the 75th Ranger Regiment is also apparent in internal standard operating procedures as every Ranger has been directed to carry a Bleeder Control Kit in a standardized location on their body. This allows the casualty or other first responders to easily locate and apply a tourniquet, pressure dressing, or other intervention as required and ensures that medical supplies are appropriately distributed and readily available to all who are wounded. This standard operating procedure was mandated by the Regimental Command Sergeant Major (CSM Michael Hall) in 2000, and was the precursor and a model for the Army’s current Individual First Aid Kit (IFAK). Also at that time, the Regimental Command Sergeant Major directed that the Bleeder Control Kit contain the Ranger Casualty Card in order to document pre-hospital

injuries and care rendered. The Ranger Casualty Card was the precursor and a model for the Army's current Tactical Combat Casualty Care Card, DA Form 7656.

The second most common medically preventable cause of combat death is a tension pneumothorax which is a pressure that accumulates within the chest cavity that affects the lung and vital organs. RFRs are taught to manage this injury by applying an occlusive dressing to the entry and exit wounds. They also learn to assess for the signs and symptoms of a tension pneumothorax, and if present, to perform a needle decompression of the chest. A needle decompression procedure entails using a 14 gauge, 3.25 inch long needle catheter to pierce the chest wall and provide immediate decompression of the chest cavity, allowing the lung to properly inflate and taking pressure off of the vital organs. Although not the definitive treatment for a tension pneumothorax, a needle chest decompression is a simple procedure that can immediately relieve the build-up of pressure in the chest cavity and buy time for the casualty to survive and be evacuated to the next level of care.

The third most common medically preventable cause of combat death is related to airway obstruction. RFRs are taught to manage an obstructed airway by using basic manual maneuvers and airway adjuncts. These basic manual maneuvers include simple movements of the head and neck in order to properly align the airway and provide adequate air movement. Airway adjuncts like the nasopharyngeal airway are used to help facilitate the airway by preventing the tongue from blocking the air passageway. Along with the ability to assess a patient's airway for patency, RFRs are taught to use critical thinking in order to determine the best treatment for a specific casualty.

The 75th Ranger Regiment provides 100% RFR instruction to all Rangers, from private to colonel, upon initial assignment to the unit and annually thereafter for refresher training. In addition to this formal training, RFR is fluidly integrated into training exercises when possible as an integral component of battle drills that are being conducted.

In keeping with General Creighton Abram's Charter for the 75th Ranger Regiment, the RFR program has been exported to many units across the military over the past decade. Global implementation of TCCC training coupled with improvements in personal protective equipment have led to the highest casualty survival rate ever during operations Enduring Freedom and Iraqi Freedom.⁶

The 75th Ranger Regiment has been continuously engaged in combat operations for greater than eight years. As such, the Regiment has maintained a constant presence in Afghanistan since 2001 and Iraq since 2003. Although as of 1 April 2010, the Regiment has sustained a total of 419 battle injuries during this timeframe, to include 28 who were killed in action and four who died of wounds, none of these fallen Rangers passed away as a result of pre-hospital medically preventable causes.^{7,8} As the Ranger First Responder has often times been called upon to provide the initial care under fire to a wounded comrade, they have undoubtedly played a significant role in reducing Ranger morbidity and mortality on the battlefield.

Ranger First Responder is not just a medical program; it is the framework of a casualty response system that relies on a mastery and immediate application of basic and critical lifesaving skills by all Rangers.⁹ However, the success of the RFR program is directly related to line command ownership of the program. Thus, the line commander owns and is responsible for the pre-hospital casualty response system and all line personnel serve as the foundation for pre-hospital care on the battlefield. The RFR program provides the critical tools necessary for a Ranger to treat a casualty. Ranger leaders ensure this training is conducted to standard and is rehearsed and integrated into training events throughout the training cycle. The end result is an increase in Ranger survivability on the battlefield and a successful completion of the Ranger mission.

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The Committee on Tactical Combat Casualty Care Defense Health Board is working with NAEMT on their TCCC course. Below are dates of courses being offered.

NAEMT Tactical Combat Casualty Care (TCCC) Provider Certification Course

WHERE:

Tavares, Florida
Lake Technical Center Institute of Public Safety Firearms Training Range
1565 Lane Park Cutoff Road
Tavares, FL 32778

WHEN:

Friday October 1, 2010 at 8:00 AM
-to-
Saturday October 2, 2010 at 5:00 PM

Register Now!

(<http://events.constantcontact.com/register/event?oeidk=a07e2z4koz46a7a60ba&oseq=a01vyeq01yxsl>)

Where:

Florida Department of Law Enforcement
Tampa Bay Regional Operations Center
4211 North Lois Avenue
Tampa, FL 33614

When:

Wednesday November 3, 2010 at 8:00 AM
-to-
Thursday November 4, 2010 at 5:00 PM
Cost: \$192.00

Register Now!

(<http://events.constantcontact.com/register/event?oeidk=a07e2zfb8uwc688d711&oseq=a01vyeq01yxsl>)

Tactical Element, Incorporated
Post Office Box 1082
Lady Lake, Florida 32158-1082
352-505-8183
800-516-7333 Fax

* Course seating is limited to 24 participants.

** Tactical Element will be delivering the National Association of EMTs Tactical Combat Casualty Care Provider Course.

*** Tactical Combat Casualty Care Provider is a prerequisite to the Tactical Combat Casualty Care Instructor course.

NAEMT Tactical Combat Casualty Care (TCCC) Instructor Certification Course

WHERE:

Tavares, Florida
Lake Technical Center Institute of Public Safety Firearms Training Range
1565 Lane Park Cutoff Road
Tavares, FL 32778

WHEN:

Sunday October 3, 2010 from 8:00 AM to 5:00 PM

Tactical Element will be delivering the National Association of EMTs Tactical Combat Casualty Care Instructor course

* Course seating is limited to 24 participants.

** Tactical Combat Casualty Care Provider certification is a prerequisite for the Tactical Combat Casualty Care Instructor course.

Register Now!

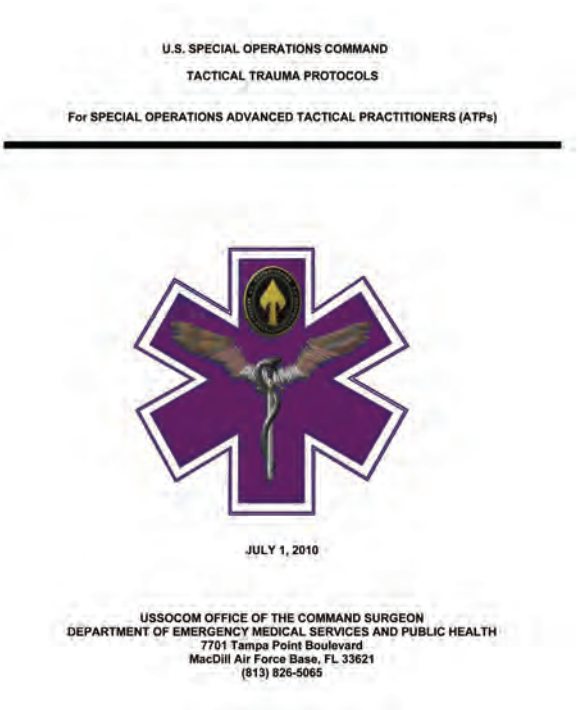
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SOF TACTICAL TRAUMA PROTOCOLS (TTPs)

SOF routinely operates in more austere environments than those of the conventional forces and conducts missions where the casualty evacuation time is measured in days rather than minutes. The SOF leadership balances those risks by providing our medics much more extensive and advanced training than their conventional counterparts. Seeking to preserve and enhance the interoperability of the SOF medical system, SOCOM has developed trauma management guidelines that mirror the principles of TCCC, while simultaneously addressing the unique needs and skills of the SOF medic.

After careful review by the USSOCOM Component Surgeons, the SOF Tactical Trauma Protocols are being published to establish an improved interoperable standard for casualty care in SOF. We understand that some of the recommendations in these guidelines may exceed the training and / or ability of an individual medic. Therefore, inclusion of a recommendation in these guidelines does not constitute authorization to perform procedures or perform treatment modalities outside those approved by the practitioner's medical control.

This edition of the JSOM will publish the SOF Tactical Trauma Protocols (TTPs) as well as they will be added to the next Training Supplement, scheduled to come out with the Winter 2011 JSOM.



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USSOCOM Tactical Trauma Protocols

July 2010

Basic Management Plan for Care Under Fire

1. Return fire and take cover.
2. Direct or expect casualty to remain engaged as a combatant if able.
3. Direct casualty to move to cover and apply self-aid if able.
4. Try to keep the casualty from sustaining additional wounds.
5. Stop life-threatening external hemorrhage if tactically feasible.
 - a. Direct casualty to control hemorrhage by self-aid if able.
 - b. For hemorrhage anatomically amenable to tourniquet application, use a CoTCCC recommended tourniquet over the uniform proximal to the bleeding site and move the casualty to cover.

Basic Management Plan for Tactical Field Care

1. Immediately remove and render safe the weapons of any casualties with altered mental status.
2. If injuries requiring urgent transport are identified, request casualty evacuation assets as soon as the tactical situation permits. Minimizing the time to surgical care is critical to survival for serious combat injuries.
3. The acronym MARCH is recommended to guide the priorities in the Care Under Fire (control of life-threatening hemorrhage only) and Tactical Field Care phases:
 - a. **M**assive hemorrhage – control life-threatening bleeding.
 - b. **A**irway – establish and maintain a patent airway.
 - c. **R**espiration – decompress suspected tension pneumothorax, seal open chest wounds, and support ventilation/oxygenation as required.
 - d. **C**irculation – establish IV/IO access and administer fluids as required to treat shock.
 - e. **H**ead injury / **H**ypothermia – prevent/treat hypotension and hypoxia to prevent worsening of traumatic brain injury and prevent/treat hypothermia.
4. Airway management:
 - a. Conscious casualties:
 - i. Allow conscious casualties with impending airway obstruction to assume any position that best protects the airway and permits self-control of secretions (including sitting up).
 - ii. Chin lift or jaw thrust maneuver
 - iii. Nasopharyngeal airway
 - b. Unconscious casualties:
 - i. Chin lift or jaw thrust maneuver
 - ii. Nasopharyngeal airway
 - iii. Place unconscious casualty into recovery position. Protect spine in blunt and blast trauma patients.
 - c. If preceding measures are unsuccessful and airway protection is required:
 - i. Normal anatomy: Consider supraglottic airway device or endotracheal intubation.
 - ii. Abnormal anatomy: Surgical cricothyroidotomy (with lidocaine if conscious).
 - iii. Use the definitive airway with which you are most experienced to increase likelihood of success.
 - d. Failed airway: Surgical cricothyroidotomy and/or other rescue airway procedure.

- e. Verify correct airway placement and patency:
 - i. Confirmation with an endotracheal tube introducer (bougie).
 - ii. Self-inflating bulb syringe (e.g.: Esophageal Intubation Detector).
 - iii. Colorimetric end tidal CO₂ detector.
 - iv. End tidal CO₂ monitor.
 - v. Do not rely on auscultation or visual misting in the ET tube to confirm placement.
 - f. Do not rely on the casualty to breathe independently through the airway device. Support ventilation using a bag valve mask (BVM) device. Automatic ventilation devices are an acceptable alternative if available.
5. Breathing:
- a. Consider a tension pneumothorax in any casualty with respiratory distress or hypotension and known or suspected torso trauma.
 - i. For suspected tension pneumothorax, decompress the chest on the side of the injury with a 14-gauge, 3.25 inch needle/catheter unit inserted into the second intercostal space at the mid-clavicular line.
 - (a) Ensure that needle entry into the chest is not medial to the nipple line.
 - (b) Ensure needle is not directed towards the heart.
 - (c) Remove needle and leave catheter in place.
 - ii. If unable to penetrate the anterior chest wall with the needle, consider the 4th or 5th intercostal space at the anterior axillary line on the affected side as an alternate decompression site.
 - iii. Repeat decompression as required for worsening or recurring symptoms/signs.
 - iv. Consider small gauge thoracostomy device or chest tube if needle decompression is unsuccessful after two attempts at each site.
 - b. Treat all open and/or sucking chest wounds by immediately applying an occlusive material to cover the defect and securing it in place. Closely monitor the casualty for the potential development of a subsequent tension pneumothorax.
6. Bleeding:
- a. Assess for unrecognized hemorrhage and control all sources of bleeding. If not already done, use a CoTCCC recommended tourniquet to control life-threatening external hemorrhage in anatomically amenable sites or for any traumatic amputation.
 - b. For significant external hemorrhage not amenable to tourniquet application, use an approved hemostatic agent with a pressure dressing.
 - c. Reassess prior tourniquet application.
 - i. If initial tourniquet is over uniform and not functioning properly, apply a second tourniquet directly to skin proximal to the original one.
 - ii. Tighten tourniquet until distal pulse is absent.
 - iii. Add another tourniquet proximally if one tourniquet on skin does not control bleeding.
 - iv. Expose and clearly mark all tourniquet sites with the time of application using an indelible marker.
 - v. If other techniques (e.g.: hemostatic or pressure dressing) are adequate to control bleeding, remove previously applied tourniquets. The goal is to remove tourniquets within 2 hours if possible.
 - d. Apply pelvic binder for treatment of suspected pelvic fracture.
7. Vascular access:
- a. Start an 18-gauge IV or saline lock if indicated.
 - b. If resuscitation is required and IV access is unobtainable, use the intraosseous (IO) route.
8. Fluid resuscitation:
- a. Assess for hemorrhagic shock. Altered mental status (in the absence of head injury) and weak or absent peripheral pulses are the best field indicators for shock.

- b. If not in shock:
 - i. No IV/IO fluids required.
 - ii. PO fluids permissible if the casualty is conscious and able to swallow.
- c. If in shock:
 - i. Initiate IV/IO Hextend and titrate to effect.
 - (a) In the absence of head injury, use normal mental status as end point.
 - (b) In the setting of traumatic brain injury (TBI) and non-compressible, internal hemorrhage, use restoration of weak radial pulse as end point.
 - (c) In the setting of TBI and controlled hemorrhage, use restoration of normal radial pulse (no BP cuff available) or SBP > 100mm Hg as end point
 - ii. Resuscitate with no more than 1,000ml of Hextend to avoid clotting problems.
 - iii. If further fluids are required, consider use of crystalloids or blood products if available.
 - iv. If RBCs and plasma are available, use them first.
- d. Continued resuscitation efforts must be weighed against logistical and tactical considerations and the risk of incurring further casualties.

9. Head injury management:

- a. Key aspects of field management of severe TBI are the prevention of hypoxia and hypotension. Ensure early establishment of a definitive airway, aggressively treat respiratory compromise, administer oxygen if available (to maintain saturation > 95%), and fluid resuscitate hypotension.
- b. Routine hyperventilation is **NOT** recommended.
- c. Controlled hyperventilation may be considered as a temporizing measure for evidence of increasing intracranial pressure (ICP) and herniation (e.g.: deteriorating mental status, unequal pupils, posturing, irregular respiratory pattern).
 - i. If end tidal CO2 monitor is available, ventilate to achieve pCO2 of 30mm Hg.
 - ii. If end tidal CO2 monitor is not available, ventilate at a rate of 20 per minute and a tidal volume of approximately 500ml.
- d. Hypertonic saline (3%) for evidence of increased ICP:
 - i. Isolated TBI (hemodynamically stable) – administer 3% HS 500ml IV/IO.
 - ii. TBI with controlled external hemorrhage - administer 3% HS 500ml IV/IO plus Hextend/other fluids as per 8c (shock) if required
- e. Seizure prophylaxis for penetrating head trauma/depressed skull fractures:
 - i. Fosphenytoin (Cerebyx®) 18mg/kg IV/IO at 100-150mg/min (slow IVP) if available.



Do not administer faster than 150mg/min since this may result in hypotension.

- ii. Repeat 100mg IV/IO Q8H for maintenance.
- f. Seizure management:
 - i. Diazepam (Valium®) 5-10mg IV/IO q 5 min to maximum dose of 20mg.
 - ii. **OR** Midazolam (Versed®) 5mg IV/IO q 5 min (no maximum dose).
 - iii. Monitor casualty closely for apnea when administering benzodiazepines.
 - iv. Fosphenytoin (Cerebyx®) 18mg/kg IV/IO at 100-150mg/min (slow IVP) if available for seizures refractory to benzodiazepines.



Do not administer faster than 150mg/min since this may result in hypotension.

- g. If cerebrospinal fluid (CSF) is identified leaking from the ears and/or nose, elevate the head 30-60 degrees if the casualty's other injuries permit and the casualty is hemodynamically stable.
- h. If the casualty exhibits signs of increased ICP and is hemodynamically stable, consider elevating the head 20-30 degrees to improve venous outflow from the brain and decrease ICP. Do not elevate the head of a hypovolemic casualty since this will reduce cerebral blood flow.


- i. Consider sedation of severe TBI after definitive airway established with midazolam (Versed) 1-2mg/hr IV/IO if no evidence of shock or hypotension.
 - j. Antibiotic prophylaxis for penetrating head trauma:
 - i. Ertapenem (Invanz®) 1gm IV/IO.
 - ii. **OR** Ceftriaxone (Rocephin®) 1gm IV/IO.
 - k. Ensure casualty is evacuated to a facility with a neurosurgeon available.
 - l. For non-severe head injuries, see *Mild Traumatic Brain Injury (MTBI) Protocol*.
10. Abdominal evisceration:
- a. Control any visible hemorrhage from bowel using approved hemostatic agent or gauze.
 - b. Irrigate gross debris off of exposed bowel.
 - c. Attempt to gently reduce bowel back into abdominal cavity.
 - i. If bowel is reduced, approximate skin (sutures or staples) and cover abdominal wound with dressing.
 - ii. If bowel is unable to be reduced, cover bowel with moist dressing.
11. Penetrating eye trauma:
- a. Perform a rapid field test of visual acuity.
 - b. Cover the eye with a rigid shield (not a pressure patch).
 - c. Ensure antibiotics are administered as per Section 19.
12. Burns:
- a. Facial burns, especially those that occur in closed spaces, are often associated with airway involvement/inhalation injury. Aggressively monitor airway status and oxygen saturation in these patients. Consider early intubation or surgical cricothyroidotomy with sedation. See *Procedural Analgesia Protocol*.
 - b. To cover burn areas, consider use of:
 - i. Silver impregnated dressings.
 - ii. Hydrogel dressings.
 - iii. Dry sterile dressings.
 - c. Fluid resuscitation for > 20% Total Body Surface Area (TBSA) 2nd/3rd degree burns:
 - i. Initiate IV/IO crystalloid administration according to "The Rule of Ten".
 - (a) Initial rate is 10ml per %TBSA per hour for a maximum casualty weight of 80kg.
 - (b) Add 100ml per hour to the rate for each 10kg above 80kg.
 - (c) Example: A 90kg casualty with 50% TBSA burn would receive an initial rate of (10ml x 50)/hr + 100ml/hr or 600ml/hr.
 - ii. If crystalloid is not available, Hextend may be used for initial resuscitation, but no more than 1,000ml of Hextend should be infused.
 - iii. Resuscitation principles for hemorrhagic shock take precedence over burn resuscitation. See Section 8c (shock) of Tactical Field Care.
 - d. If trained, consider escharotomy for:
 - i. Circumferential extremity burns with compromised circulation.
 - ii. Circumferential thoracic burns with compromised ventilation.
 - iii. Limit escharotomy incision to depth of burn.
 - e. Do not administer prophylactic antibiotics for burns without other combat wounds.
 - f. Splint burned hands and feet in position of function with dressings separating digits.
 - g. Aggressive pain management for critical burn patients.
 - h. Aggressive hypothermia prevention management, especially for extensive burns.
 - i. All trauma care interventions can be performed through burned skin.
13. Inspect and dress all wounds.
14. Fracture/dislocation management:
- a. Attempt to reduce pulseless fractured extremities and dislocations.
 - b. Dislocations with distal pulse may be reduced based on evacuation time and training/experience in procedure.
 - c. Splint and recheck pulse.

15. Crush injuries:
 - a. Severe and extensive crush injuries may be seen in patients trapped under an overturned vehicle or in a collapsed structure such as a bombed building.
 - b. Entrapment may be prolonged due to the requirement for specialized rescue equipment.
 - c. See *Crush Syndrome Protocol*.
16. Hypothermia management:
 - a. Hypothermia will result in decreased clotting ability in the trauma casualty. Prevention is the key to management, since only limited rewarming is possible in the field.
 - b. Minimize the casualty's exposure to the elements. Keep protective gear on or with the casualty if feasible.
 - c. Remove wet clothing and replace with dry garments if possible.
 - d. Wrap casualty with available insulating material (e.g.: CoTCCC recommended commercial systems, sleeping bags, or anything that will retain heat and keep the casualty dry).
 - e. If resuscitation is required, use warmed IV fluids if possible.
17. Monitoring:
 - a. Frequently reassess the casualty.
 - b. Utilize available monitoring devices (e.g.: pulse oximeter, cardiac monitor, etc.).
18. Analgesia:
 - a. If able to fight, casualty should take pain medications carried in combat pill pack:
 - i. Meloxicam (Mobic®) 15mg PO
 - ii. Acetaminophen (Tylenol®) 1gm PO
 - b. If unable to fight or there is need for opiate analgesia to control pain:
 - i. Naloxone (Narcan®) should be available whenever administering opiates. Monitor for respiratory depression.
 - ii. Oral transmucosal fentanyl citrate (OTFC) 400-800µg orally:
 - (b) Start with lower dose if unsure of response
 - (c) Tape OTFC lozenge to casualty's finger as an added safety measure.
 - (d) Reassess in 15 minutes
 - (e) Repeat dose once if necessary.
 - iii. **OR** Morphine sulfate 5-10mg IV/IO:
 - (a) Reassess in 10 minutes.
 - (b) Repeat dose as required.
 - iv. Ondansetron (Zofran®) 4-8mg IV/IO/IM/SL q8hr as needed for nausea.
 - c. See *Procedural Analgesia Protocol* for analgesia for painful procedures.
19. Antibiotics:
 - a. Prophylactic use is recommended for all open combat wounds.
 - b. Prophylactic use is **not** recommended for burns in the absence of other concomitant combat wounds.
 - c. If able to take oral medications, moxifloxacin (Avelox®) 400mg PO from combat pill pack.
 - d. If unable to take oral medications, ertapenem (Invanz®) 1 gm IV/IO/IM.
20. Cardiopulmonary resuscitation (CPR):
 - a. Battlefield CPR for blunt, blast or penetrating trauma casualties, who have no pulse, respirations, or other signs of life, will not be successful and should not be attempted.
 - b. CPR may be considered depending on the tactical situation in certain types of casualties:
 - i. Severe hypothermia.
 - ii. Chemical warfare agent/toxic exposures (if appropriate antidotes are available).
 - iii. Crush syndrome (if ACLS treatments for hyperkalemia are available). See *Crush Syndrome Protocol*.
 - iv. Electrocution.

21. Communication / Documentation of care:
 - a. Explain procedures and treatments to casualty to reassure and reduce anxiety.
 - b. Document clinical assessments, treatments rendered, and changes in casualty's status on a SOF Casualty Card. Forward this information with the casualty to the next level of care.

Extended Tactical Field Care Considerations


1. The unique nature of SOF missions may require tactical field care lasting hours to days before evacuation can be achieved. Identify the potential for prolonged tactical field care during mission planning in order to prepare increased amounts of medical supplies (e.g.: carried on vehicles) and/or resupply bundles. Extended Tactical Field Care is presumed to exist when evacuation cannot be performed within the 4 hour time frame doctrinally dictated for Priority patients.
2. Airway Management:
 - a. Reverify airway patency and security in a consistent manner.
 - b. Suction: Consider periodic suctioning of the oropharynx and endotracheal tube.
 - c. Pulmonary toilet: Consider periodic saline flushes (2ml) to clear mucus/blood from ET tube.
 - d. Local wound care at cricothyroidotomy site if applicable.
3. Respiratory Management:
 - a. Place a small gauge thoracostomy device or chest tube placement if casualty required needle decompression previously.
 - b. Apply negative pressure to chest tube if available, not exceeding -20cm water.
 - c. Consider rib blocks for pain management.
 - d. If available, administer oxygen to maintain O₂ saturation > 90% (>95% for TBI).
 - e. If patient is being ventilated, maintain strict bagging cycles (1 breath every 5 seconds) and a tidal volume of approximately 500ml to allow for complete exhalation and avoid stacking breaths.
 - f. Consider the use of a ventilator/assist device if available. If the device permits, add physiologic positive end-expiratory pressure PEEP (3-5cm water).
 - g. Consider sedation with midazolam (Versed) 1-2mg/hr IV/IO in casualties requiring prolonged intubation/ventilation if no shock or hypotension.
4. Flail chest management:
 - a. Monitor for developing hypoxia secondary to pulmonary contusions.
 - b. Casualty may require positive pressure ventilation.
 - c. Ensure adequate analgesia. Consider rib blocks for pain management.
 - d. These casualties frequently fatigue and require intubation/definitive surgical airway.
5. Fluid management:
 - a. Conscious: Instruct casualty to drink clear liquids up to 1 liter per hour; consider oral electrolyte supplementation if available.
 - b. Unconscious: Insert Foley catheter and titrate IV/IO/NG/PR crystalloid fluids to maintain urine output of 30-50ml/hr.
 - i. Clean water may be utilized in lieu of crystalloid for NG/PR infusion.
 - ii. Maximum PR fluid infusion rate for stable patients is 200ml/hr.
 - iii. Maximum PR fluid infusion rate for volume depleted patients is 500ml/hr
 - c. Critical burn (> 20% TBSA of 2nd/3rd degree burns):
 - i. Insert Foley catheter.
 - ii. Continue fluid resuscitation according to "The Rule of Ten".
 - (a) Initial rate is 10ml per %TBSA per hour for a maximum casualty weight of 80kg.
 - (b) Add 100ml/hr to the rate for each 10kg above 80kg.
 - (c) Example: A 90kg casualty with 50% TBSA burn would receive an initial rate of (10ml x 50)/hr + 100ml/hr or 600ml/hr.

- iii. Adjust fluid rate to maintain urine output of 30-50ml/hr.
 - iv. Oral fluid administration may be acceptable in burns up to 40% TBSA if crystalloid supplies are limited. Larger burns are associated with ileus and significantly decreased bowel absorption. Use WHO oral rehydration packets if available.
6. Wound care management:
- a. Irrigate and redress wounds (any potable water can be used for irrigation).
 - b. Debride only **obviously** devitalized tissue.
 - c. Change dressings every 24 hours. Consider converting to silver impregnated dressings to reduce frequency of dressing changes.
 - d. Continue antibiotics. Repeat moxifloxacin (Avelox®) 400mg PO or ertapenem (Invanz®) 1gm IV/IO/IM every 24 hours.
7. Analgesia:
- a. See *Procedural Analgesia Protocol* for procedures.
 - b. Consider local blocks for pain management.
8. Nutrition management:
- a. Consider oral nutrition if evacuation will be delayed by over 24 hours.
9. Orthopedic/Compartment Syndrome management:
- a. Apply traction splints as required.
 - b. Reassess fractures and splint in position of function.
 - c. Check neurovascular status after any manipulation.
 - d. Be suspicious of compartment syndrome in the following conditions:
 - i. Fractures.
 - ii. Crush injuries.
 - iii. Vascular injuries.
 - iv. Circumferential burns.
 - v. Multiple penetrating injuries (fragmentation).
 - e. Clinical signs of compartment syndrome:
 - i. Pain out of proportion to injury.
 - ii. Pain with passive motion of muscles in the involved compartment.
 - iii. Pallor.
 - iv. Paresthesias.
 - iv. Pulselessness
-  Be aware that peripheral pulses are present in 90% of patients with compartment syndrome.
- f. Consider use of compartment pressure monitor if available and trained in its use.
 - g. Increasing swelling, decreasing motion, and increasing pain not responsive to analgesics in the appropriate clinical setting should raise the possibility of a developing compartment syndrome.
 - h. Compartment syndromes make take hours to develop. For patients with suspected compartment syndrome, reevaluate every 30 minutes for 2 hours, then every hour for 12 hours, then every 2 hours for 24 hours, then every 4-6 hours for 48 hours..
 - i. Extremity compartment syndromes may occur in the thigh, lower leg/calf, foot, forearm, and hand.
 - j. Compartment syndrome management:
 - i. Maintain extremity at level of heart. **Do not elevate.**
 - ii. Loosen encircling dressings.
 - iii. Urgent evacuation.
 - k. Fasciotomy:
 - i. Only consider if evacuation is delayed 6 hours or longer and fasciotomy is within the scope of the treating medic/ATP.
 - ii. See *Fasciotomy Protocol*.

10. Special blast injury considerations:
 - a. Tympanic membranes:
 - i. Inspect for perforation if possible.
 - ii. Presume perforation in the setting of post-blast hearing loss.
 - iii. Dexamethasone (Decadron) 10mg IV/IO/IM/PO QD x 5 days for hearing loss if not contraindicated by other injuries.
 - b. Lungs:
 - i. Pulmonary overpressure may result in delayed lung injury.
 - ii. Monitor patients closely for respiratory deterioration for at least 6 hours post-blast.
 - c. Abdomen:
 - i. Blast overpressure may result in bowel injury and delayed perforation.
 - ii. Acute abdominal pain, especially with evidence of peritoneal irritation, within 72 hours of blast exposure should be presumed to be a bowel perforation. *See Abdominal Pain TMEP.*
 - d. Spine:
 - i. Patients involved in vehicular blasts or thrown by explosions are at high risk for spinal injury.
 - ii. Maintain a high index of suspicion for spinal injury, especially in unconscious patients.

Basic Management Plan for Tactical Evacuation (TACEVAC) Care

1. Airway management:
 - a. Confirm airway placement.
 - b. Reassess airway patency.
2. Breathing:
 - a. Reassess patient for development of tension pneumothorax.
 - b. Place a small gauge thoracostomy device or chest tube if:
 - i. Patient requires any needle decompressions.
 - ii. **OR** no improvement with needle decompression.
 - iii. **OR** evacuation time is prolonged (greater than 1 hour).
 - iv. **OR** evacuation requires transport at high altitude in unpressurized aircraft.
 - c. If available, provide oxygen as needed to maintain O2 saturation > 90% (> 95% for TBI).
3. Bleeding:
 - a. Reassess patient and verify bleeding is controlled.
 - b. Verify distal pulses are absent in extremities with tourniquets.
 - c. Reassess if tourniquet is required or other hemorrhage control means are appropriate.
4. Vascular access:
 - a. Reassess IV patency.
 - b. Flush IV lines as required.
5. Fluid resuscitation:
 - a. Continue resuscitation with blood products, colloid, or crystalloid as indicated.
 - b. Maintain a palpable radial pulse or systolic blood pressure of 90mm Hg in all unconscious patients with non-compressible, internal hemorrhage as per Tactical Field Care Section 8 (shock).
 - c. Maintain a normal radial pulse character or systolic blood pressure > 100mm Hg in TBI patients with altered mental status and controlled hemorrhage as per Tactical Field Care Section 8 (shock).

6. Head injury management:
 - a. Continue to prevent hypotension and hypoxia.
 - b. Administer 3% Hypertonic Saline 500ml IV/IO for severe TBI if not already done or patient is continuing to deteriorate rapidly as per Tactical Field Care Section 9 (head injury).
7. Hypothermia management:
 - a. Continue hypothermia prevention management or initiate if not already started.
 - b. Utilize heating system on evacuation platform and avoid wind exposure.
 - c. Use an IV warming device for all fluid administration.
8. Monitoring:
 - a. Institute electronic monitoring of vital signs.
9. Check for additional wounds.
 - a. Dress all wounds.
10. Continue analgesia as required.
11. Reassess fractures and neurovascular status.
 - a. Consider use of traction splints.
12. Antibiotics:
 - a. Initiate for all open combat wounds if not already given.
13. Consider use of pneumatic anti-shock garment (PASG) for stabilizing pelvic fractures.
 - a.  **DO NOT USE** in patients with thoracic or brain injuries.
 - b. If PASG not available, use pelvic binder if not already applied previously.
14. Air evacuation/altitude considerations:
 - a. Monitor air pressure in extremity air splints during altitude changes.
 - b. Replace air with saline in endotracheal tube cuffs.
15. Documentation of Care:
 - a. Explain procedures and treatments to patient to reassure and reduce anxiety.
 - b. Document clinical assessments, treatments rendered, and changes in patient status on a SOF Casualty Card. Forward this information with the casualty to the next level of care.

CRUSH SYNDROME PROTOCOL

SPECIAL CONSIDERATIONS:

1. Be aware of development of crush syndrome starting as early as 4 hours post injury.
2. These medications are not part of the standard ATP aid bag and require development of a separate crush injury kit.



The principles of hypotensive resuscitation according to TCCC DO NOT apply in the setting of extremity crush injury requiring extrication.



In the setting of a crush injury associated with non compressible (thoracic, abdominal, pelvic) hemorrhage, aggressive fluid resuscitation may result in increased hemorrhage.



With extremity injuries, tourniquets should NOT be applied during Phase 1 unless there is hemorrhage which is not controllable by other means.



Be aware of development of cardiac dysrhythmias due to hyperkalemia immediately following extrication.

DEFINITION:

Massive, prolonged crush injury resulting in profound muscle and soft tissue damage places the patient at significantly increased risk for developing circulatory and renal complications.



MANAGEMENT:

PHASE 1: IMMEDIATE (while attempting extrication):

1. Maintain patent airway (NPA, OPA, etc.) and adequate ventilation.
2. Monitor O2 sat with pulse ox and administer high flow oxygen if available.
3. Give initial bolus of 1-1.5L of NS **PRIOR** to attempts at extrication and continue at 1.5L/hr.



Ringer's lactate is not recommended due to the potassium content.

4. Maintain urine output at greater than or equal to 200cc/hr. If possible, insert Foley catheter.
5. Assess and reassess mental status.
6. Follow *Pain Management Protocol (TMEP)*
7.  Consider prophylactic antibiotics – Ertapenem (Invanz) 1gm IV.
8. Utilize Propack or AED cardiac monitoring if available.
9.  Mannitol (administer 1 – 2gm/kg at a rate of 5gm/hr).




Ensure urine output has been established prior to using Mannitol.

PHASE 2: IMMEDIATELY PRIOR TO EXTRICATION:



10. Immediately prior to extrication, apply tourniquets to crushed extremities, if possible.

Phase 2 Recommended Additional Resuscitative Drugs

11.  Sodium Bicarbonate – give 1mEq/kg IV immediately prior to extrication (Bristojet 1 – 2 amps). Additional dosing of Sodium bicarbonate may be required if dysrhythmias or cardiac arrest persist after giving calcium chloride or gluconate


PHASE 3: IMMEDIATELY FOLLOWING EXTRICATION

Cardiac Dysrhythmias or Arrest

12.  CPR **should be** initiated if cardiac arrest develops following extrication. **DO NOT** follow the TCCC guidelines on cardiac arrest.
13.  If extrication is greater than 4 hours **OR** in the presence of dysrhythmias, administer Calcium Chloride (1gm, 10ml of 10% solution) or Calcium Gluconate (1gm, 10ml of 10% solution).



Calcium should not be given in bicarbonate containing solutions due to precipitation of calcium carbonate.

14.  Additional dosing of Sodium bicarbonate may be required if dysrhythmias or cardiac arrest persist after giving calcium chloride or gluconate
15. Following extrication, once the patient is stabilized, be prepared to treat hyperkalemia as tourniquets are released.

DISPOSITION:



Urgent Surgical evacuation

FASCIOTOMY PROTOCOL

SPECIAL CONSIDERATIONS:

1. COMPARTMENT SYNDROMES REQUIRE A HIGH INDEX OF SUSPICION.
2. DO NOT ATTEMPT THESE PROCEDURES IF NOT TRAINED OR QUALIFIED.

SIGNS AND SYMPTOMS

1. Be suspicious of compartment syndrome in the following conditions:
 - A. Fractures
 - B. Crush injuries
 - C. Vascular injury
 - D. Circumferential burns
 - E. Multiple penetrating injuries (fragmentation)
 - F. Blunt trauma
2. Clinical signs: Accurate diagnosis requires a high rate of suspicion.
 - A. "Classic: Late Signs – 5Ps"
 - 1) Pain
 - 2) Pallor
 - 3)  Pulselessness : Be aware that peripheral pulses are present in 90% of patients with compartment syndrome.
 - 4) Paresthesia
 - 5) Paralysis
 - B. More common acute findings
 - 1) Increasing pain
 - 2) Pain out of proportion to injury
 - 3) Pain with passive motion of muscles in the involved compartment
 - 4) Pallor
 - 5) Paresthesia (numbness)
 - C. Increasing swelling, decreasing motion, and increasing pain not responsive to pain medication in the appropriate clinical setting should raise the possibility of a developing compartment syndrome.
 - D.  Compartment syndromes may take hours or days to develop. For patients with suspected compartment syndromes, re-evaluate q 30 minutes for 2 hours, then q1hr for 12 hours, then q2hrs for 24 hours and then q4-6hrs for 48 hours.
 - E. Compartment Syndromes may occur in the: Thigh, Lower leg/ Calf, Foot, Forearm, Hand

MANAGEMENT

1. Orthopedic/Compartment Syndrome Management.
2. Apply traction splints as necessary.
3. Assess fractures and splint in position of function.
4. Check neurovascular status after any manipulation.
5. Use compartment pressure monitor if available
 - A. Perfusion pressure = diastolic blood pressure – measured intramuscular pressure
 - 1) Perfusion Pressure < 30mm is diagnostic for compartment syndrome
 - 2) Hypotensive patients have a lowered diastolic pressure and may have increased susceptibility to developing a compartment syndrome.
 - B. Repeat measurements if clinically indicated or if patient is obtunded due to narcotic use or head injury
6. Non Surgical Treatment
 - A. Pain Management: See *Pain Management TMEP*





- 1)  Increasing pain medication requirements may mask development of a compartment syndrome
- 2)  Narcotic doses which decrease the Soldier's level of consciousness and cause drowsiness will overshadow a patient so that the increasing pain of a compartment syndrome is not recognized.
- B. Elevation – Maintain extremity at level of the heart. **DO NOT ELEVATE.**
- C. Loosen encircling dressings
7. Surgical (Fasciotomy)
 - A. See *Procedural Analgesia Protocol* prior to doing procedures
 - B.  Only consider fasciotomy if:
 - 1) Evacuation is delayed 6 hours or longer
 - 2) **AND fasciotomy is within the scope of practice of the treating medic**
 - 3) **AND** the following indications exist:
 - a. Pain with passive motion of the involved muscle group
 - i. Increasing pain with decreasing response to pain meds
 - ii. Increasing swelling and tightness in the involved compartment
 - 4) **OR** There are elevated compartment pressures as defined above (#5).
 - C.  Fasciotomy may be a limb saving procedure in the proper clinical setting. When done for the wrong reasons, or done incorrectly, the potential for serious complications exists.
 - D. Procedure: Utilize *Procedural Analgesia Protocol*
 - 1) Thigh: anterior skin incision, ID muscle fascia and split fascia only
 - 2) Lower leg/ Calf:
 - a. Anterior and Lateral Compartments:
 - i. Identify the anterior tibial crest and then identify the fibula. Make the skin incision from the proximal third to the distal third of the foreleg. The incision is located approximately 2cm anterior to the fibula.



Fig 1: The incision is anterior to the fibula. The lines on the foot are used **ONLY** for a foot compartment syndrome.

- ii. Identify the intermuscular septum if possible. Make the anterior fascial incision parallel to the tibial crest and about 1 inch lateral to the tibial crest. The fascial incision should be the length of the skin incision. This releases the anterior compartment. To release the lateral compartment, identify the intermuscular septum approximately half way between the fibula and the anterior tibial crest. Posterior to

this septum, incise the fascia from the proximal aspect to the distal third of the foreleg.

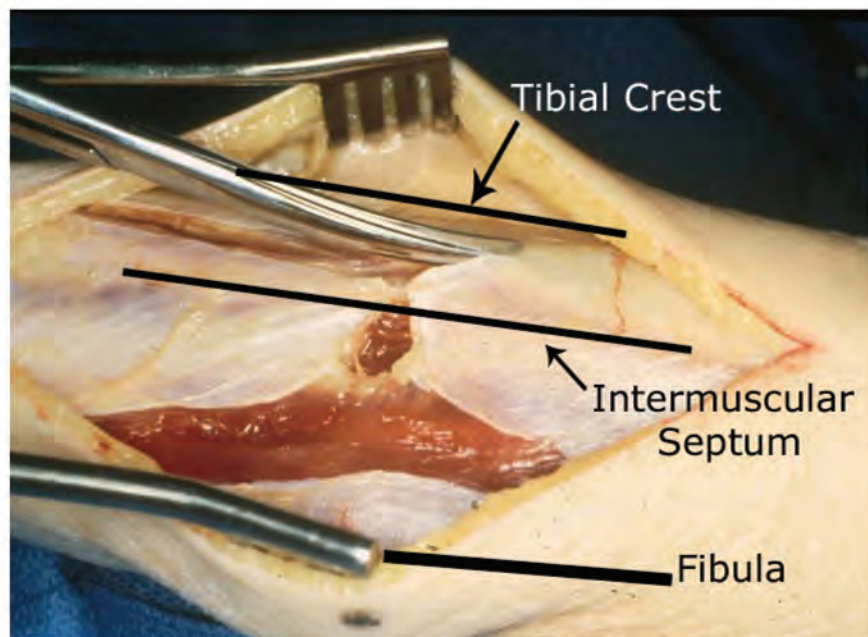


Fig 2: Identify the tibia, fibula and the intermuscular septum. Make the Fasciotomy incisions anterior and posterior to the septum.

b. Posterior Compartment:

- i. Make an incision at the posteromedial aspect of the calf from the proximal muscle distally to the distal third of the foreleg. ID the fascia and split the fascia of the superficial muscles. To release the deep posterior compartment, develop the interval between posterior border of the tibia and the superficial posterior compartment. Proceed deep along the posterior border of the tibia. Identify the deep posterior compartment and release the fascia. Be careful of the deep neurovascular structures.



Fig. 3: The dotted line represents the palpable tibial border and the solid line on the tibia represents the incision line. The solid line on the foot is done ONLY for foot compartment syndromes.

- 3) Foot: Make longitudinal incisions between the metacarpals along the dorsal aspect of the foot as shown in figure 1. ID the underlying fascia and incise it. Make a medial foot incision as shown in figure 3 and incise the underlying fascia.
- 4) Forearm: Make 20cm longitudinal incisions along the dorsal and volar aspects of the forearm. Identify the underlying fascia and split the fascia. Avoid cutting tendons and nerves.



Fig. 4: Dorsal arm incision for forearm dorsal compartment release.
Dorsal hand incisions used only for hand compartment syndrome.



Fig.5: Volar arm incision used for forearm compartment syndrome release.

- 5) Hand: Make a 5cm longitudinal incision between the 2nd and 3rd, and the 3rd and 4th metacarpals on the dorsal aspect of the hand as shown in figure 4. Avoid cutting the extensor tendons. Split the underlying fascia.
- E. Leave all wounds open and apply dressings.
 - F. Urgent evacuation

MILD TRAUMATIC BRAIN INJURY (MTBI)

SPECIAL CONSIDERATIONS:

1. Mandatory events requiring MACE:
 - a. Personnel in a vehicle associated with a blast, collision or rollover
 - b. Personnel within 150 meters of a blast
 - c. Personnel with a direct blow to the head
 - d. Command directed evaluation
2. NOT allow a patient with a mTBI to return to duty while they are symptomatic. This puts them at significant risk for greater injury (to include death) if they sustain another head injury while still symptomatic.
3. mTBI is primarily a clinical diagnosis. If you do not feel that a patient is back to their baseline, do not allow them to RTD and consult a medical provider

SIGNS AND SYMPTOMS:

1. Red Flags (Symptoms):

- A. Neurological
 - 1) Witnessed loss of consciousness
 - 2) Amnesia/memory problems
 - 3) Unusual behavior/combatative
 - 4) Seizures
 - 5) Worsening headache
 - 6) Cannot recognize people
 - 7) Disoriented to time and/or place
 - 8) Abnormal speech
- B. Eyes
 - 1) Double vision
- C. General
 - 1) 2 or more blast exposures within 72 hours
 - 2) Repeated vomiting
 - 3) Weakness
 - 4) Unsteady on feet

MANAGEMENT:

1. Consider mTBI (concussion) in anyone who is dazed, confused, "saw stars", lost consciousness (even if just momentarily) or has memory loss that results from a fall, explosion, motor vehicle crash or any other event involving abrupt head movement, a direct blow to the head or other head injury
2. Triage and treat other injuries as required. As soon as tactically feasible evaluate for mTBI
3. Red Flags present
 - A. If red flags are present - consult with medical provider for possible urgent evacuation.
4. Administer MACE
 - A. If MACE <25 or symptoms persist despite rest and appropriate treatment consult with medical provider for possible priority evacuation.
 - B. If MACE is normal:
 - a. Recommend 24 hour rest and re-evaluate
5. Follow Service specific, DVBIC, JTTG guidelines



6. Contraindications:

- A. If possible, avoid the use of Cox 1 NSAID medication (Motrin/ibuprofen, Aleve/naprosyn) due to effects on platelets and a potentially increased risk of bleeding. If COX 1 NSAIDS are the only medication available and the patient has no red flags they MAY be used to treat the headache.
- B. Avoid the use of tramadol (Ultram) due to its effects on platelets, increased bleeding and altered level of consciousness.
- C. Avoid the use of diphenhydramine (Benadryl) due to possibly alteration of the patient's level of consciousness

D. Avoid the use of narcotics due to alteration of the patient's level of consciousness

DISPOSITION:

- *Urgent* evacuation in the presence of Red Flags
- *Priority* evacuation in the presence of MACE <25 and persistent symptoms despite appropriate treatment and rest
- *Routine* evacuation MACE persistently <25 OR MACE >25 and persistent symptoms despite appropriate treatment



Military Acute Concussion Evaluation (MACE)

Defense and Veterans Brain Injury Center

Patient Name: _____

SS#: _____ Unit: _____

Date of Injury: ____/____/____

Time of Injury: _____

Examiner: _____

Date of Evaluation: ____/____/____

Time of Evaluation: _____

History: (I – VIII)

I. Description of Incident

Ask:

- What happened?
- Tell me what you remember.
- Were you dazed, confused, "saw stars"?
Yes No
- Did you hit your head? Yes No

II. Cause of Injury (Circle all that apply):

- Explosion/Blast
- Blunt object
- Motor Vehicle Crash
- Fragment
- Fall
- Gunshot wound
- Other _____

III. Was a helmet worn? Yes No

Type _____

IV. Amnesia Before: Are there any events just BEFORE the injury that are not remembered? (Assess for continuous memory prior to injury) Yes No If yes, how long _____

V. Amnesia After: Are there any events just AFTER the injuries that are not remembered? (Assess time until continuous memory after the injury) Yes No If yes, how long _____

VI. Does the individual report loss of consciousness or "blacking out"? Yes No If yes, how long _____

VII. Did anyone observe a period of loss of consciousness or unresponsiveness? Yes No If yes, how long _____

VIII. Symptoms (circle all that apply)

- Headache
- Dizziness
- Memory Problems
- Balance problems
- Nausea/Vomiting
- Difficulty Concentrating
- Irritability
- Visual Disturbances
- Ringing in the ears
- Other _____

Examination: (IX – XIII)

Evaluate each domain. Total possible score is 30.

IX. Orientation (1 point each)

Month:	0	1
Date:	0	1
Day of Week:	0	1
Year:	0	1
Time:	0	1

Orientation Total Score ____/5

08/2006

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Military Acute Concussion Evaluation (MACE)

Defense and Veterans Brain Injury Center

X. Immediate Memory:

Read all 5 words and ask the patient to recall them in any order. Repeat two more times for a total of three trials.

(1 point for each correct, total over 3 trials)

List	Trial 1		Trial 2		Trial 3	
Elbow	0	1	0	1	0	1
Apple	0	1	0	1	0	1
Carpet	0	1	0	1	0	1
Saddle	0	1	0	1	0	1
Bubble	0	1	0	1	0	1
Trial Score						

Immediate Memory Total Score ____/15

XI. Neurological Screening

As the clinical condition permits, check

Eyes: pupillary response and tracking

Verbal: speech fluency and word finding

Motor: pronator drift, gait/coordination

Record any abnormalities. **No points are given for this.**

XII. Concentration

Reverse Digits: (go to next string length if correct on first trial. Stop if incorrect on both trials.) 1 pt. for each string length.

4-9-3	6-2-9	0	1
3-8-1-4	3-2-7-9	0	1
6-2-9-7-1	1-5-2-8-5	0	1
7-1-8-4-6-2	5-3-9-1-4-8	0	1

Months in reverse order:

(1 pt. for entire sequence correct)

Dec-Nov-Oct-Sep-Aug-Jul

Jun-May-Apr-Mar-Feb-Jan 0 1

Concentration Total Score ____/5

XIII. Delayed Recall (1 pt. each)

Ask the patient to recall the 5 words from the earlier memory test (Do NOT reread the word list.)

Elbow	0	1
Apple	0	1
Carpet	0	1
Saddle	0	1
Bubble	0	1

Delayed Recall Total Score ____/5

TOTAL SCORE ____/30

Notes: _____

Diagnosis: (circle one or write in diagnoses)

No concussion

850.0 Concussion without

Loss of Consciousness (LOC)

850.1 Concussion with

Loss of Consciousness (LOC)


Other diagnoses _____

McCrea, M., Kelly, J. & Randolph, C. (2000). *Standardized Assessment of Concussion (SAC): Manual for Administration, Scoring, and Interpretation*. (2nd ed.) Waukesa, WI: Authors.

Defense & Veterans Brain Injury Center
 1-800-870-9244 or DSN: 662-6345

PROCEDURAL ANALGESIA PROTOCOL

SPECIAL CONSIDERATIONS:

1. Intended for performing brief, significantly painful procedures such as chest tube insertion or fracture reduction.
2. Prior to initiating this protocol, the following should be accomplished:
 - A. Vascular access.
 - B. Airway equipment, suction, and bag valve mask device immediately available and within reach.
 - C. Monitoring equipment (if available) on and attached to patient (if tactically feasible).
3.  Concomitant administration of narcotics and benzodiazepines increases the risk for respiratory depression and hemodynamic instability. Use caution. Do not use in patients with shock or hypotension.
4. Once the protocol has been initiated, monitor patient vigorously.

SINGLE AGENT


1. Morphine 5mg IV/IO q 5 min to a maximum total dose of 20mg.
2. In the event of respiratory depression, administer naloxone (Narcan®) in 0.1 mg IV/IO increments until respiratory effort is adequate.

DUAL AGENT

1. Midazolam (Versed®) 2mg IV/IO over 1 minute, followed by 0.5-1mg increments after 5 minutes to a maximum total dose of 4mg.
2. **PLUS** ketamine (Ketalar®) 20mg IV/IO over 1 minute, followed by 20mg increments every 30- 60 seconds until nystagmus occurs or a maximum total dose of 100mg.


Fosphenytoin (Cerebyx®)



- **WARNING** GROUNDING medication for personnel on flight status
- Description: Parenteral phenytoin
- Indications:
 - Prevention and treatment of seizures
- Dose: 18mg/kg IV/IO at 100-150mg/min (slow IVP) or 18mg/kg IM for seizures refractory to benzodiazepines.
 -  **Do not administer fosphenytoin faster than 150mg/min since this may result in hypotension.**
- **Contraindications:**
 - Hypersensitivity to phenytoin
 - Sinus bradycardia
 - AV block
- Pregnancy Category D
- Adverse Effects
 - Hypotension with rapid IV administration
- Other Notes
 - **Refrigerate, if possible, when not required for missions.**
 - **Vials that develop particulate matter or are discolored should not be used.**
 - Because the full antiepileptic effect of phenytoin, whether given as Cerebyx or parenteral phenytoin, is not immediate, other measures, including concomitant administration of an IV benzodiazepine, will usually be necessary for the control of status epilepticus
- TMEP Use:
 - Seizure Protocol
 - Tactical Trauma Protocols

Ketamine (Ketalar®)



- **WARNING** GROUNDING medication for personnel on flight status
- Description: Rapid acting general sedative and analgesic
- Indications:
 - Anesthetic agent for procedures
- Adult Dose: 20mg IV/IO over 1 minute, followed by 20mg increments every 30- 60 seconds until nystagmus occurs or a maximum total dose of 100mg.
 -  **Do not administer faster as this may result in respiratory depression.**
- **Contraindications:**
 - Hypersensitivity to ketamine
 - Eye globe injury
 - Head injury
- Pregnancy Category B
- Adverse Effects
 - Hypertension
 - Respiratory Depression
 - Emergence Reactions (delirium, hallucinations, confusion)
 - Increased Intra-cranial pressure
 - Increased intra-ocular pressure
- Other Notes
 - Do not mix ketamine hydrochloride and diazepam in syringe or infusion bottle
 - Ketamine **should not** be injected intravenously without proper dilution. It is recommended the drug be diluted with an equal volume of either Sterile Water for Injection, USP, Normal Saline, or 5% Dextrose in Water.
 - Protect from light
 - Effects of ketamine are increased when combined with other analgesics or muscle relaxants
 - **Vials that develop particulate matter or are discolored should not be used.**
- TMEP Use:
 - Procedural Analgesia Protocol

2010 USSOCOM Tactical Trauma Protocols

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SEIZURE






SPECIAL CONSIDERATIONS:

1. May be caused by injury, infection, high fever, alcohol withdrawal, drug use, toxins, and structural abnormalities of the central nervous system (CNS).
2. Possible history of previous seizures, recent head trauma, CNS infection, or headaches

SIGNS AND SYMPTOMS:

1. Involuntary repetitive muscle movements that are abrupt in onset
2. Associated unresponsiveness
3. Typically lasts 90-120 seconds.
4. Followed by period of confusion and somnolence (postictal state)
5. Evidence of recent seizure activity may include urinary incontinence and acute intraoral trauma (e.g.: tongue biting)

MANAGEMENT:

1. Avoid trauma to patient during the seizure, but do not restrain patient.
2.  Diazepam (Valium) 5-10mg IV/IO q 5 min or 10mg IM q 15 min to a maximum dose of 20mg.
3.  **OR** Midazolam (Versed) 5mg IV/IO q 5 min or 5-10mg IM q 15 min (no maximum dose)
4.  Fosphenytoin (Cerebyx) 18mg/kg IV/IO at 100-150mg/min (slow IVP) or 18mg/kg IM for seizures refractory to benzodiazepines.
 - A.  **Do not administer fosphenytoin faster than 150mg/min since this may result in hypotension.**
5. Do not attempt to force an object into the mouth to open airway.
6. Support and maintain airway and ventilation as needed to include SPO₂.
7. If seizures are accompanied by fever,
 - A. Consider meningitis and treat per *Meningitis Protocol*.
 - B. Consider malaria if in malaria endemic area and treat per *Malaria Protocol*
8.  Place either 1 tube Glutose (oral glucose gel) or contents of 1 sugar packet in buccal mucosa to treat possible hypoglycemia.

DISPOSITION: Urgent evacuation

The following is a topic that the *JSOM* has published before, but can't be covered too much.

BOGUS TOURNIQUETS COULD ENDANGER LIVES IN COMBAT

Steve Elliott

Fort Sam Houston Public Affairs

Counterfeit models of the U.S. Army's Combat Application Tourniquet are available on the Internet and on the open market.

Using the counterfeits can be lethal and the Army considered this enough of a problem to send out a priority message April 14 sounding the alert on these bogus devices.

"While I haven't seen any of these counterfeits in use, I have seen a few ordered by logisticians more interested in cutting costs than in quality control," said COL John Kragh, U.S. Army Institute of Surgical Research at Fort Sam Houston.

"The Combat Application Tourniquet is standard issue to all deploying Soldiers. It's in each Soldier's Individual First Aid Kit pouch."

Kraugh explained the Army's concern with the counterfeits.

"The rod on the dummy tourniquet is bendable to a point where it cannot work right. It's like bending Gumby's arm," he said. "The makers do not market the item ostensibly as a medical device, but they sell it and package it like a retail item."

"The danger is if someone mistakes the fake for a real CAT or a real medical device," the COL said. "That mistake could be fatal, since it cannot control bleeding."

The message said that the Defense Logistics Agency knows the fake items are available for purchase through non-Department of Defense websites, and that authorized DoD procurement gateways will supply only the approved commercial part from authorized distributors.

If the counterfeits are found in any inventory, they should be replaced by the real thing and the counterfeit should be reported to that activity's logistical supply office.

"It's easy to get the right items using routine, professional supply channels," Kragh said. "If other channels are used, then it's easy to get the wrong stuff. It just takes a credit card and choosing the wrong online supplier."

The message said the phony tourniquet was first encountered several years ago in a depot in Afghanistan and was thought to have been purged from the system. At that time, the item was of obviously inferior construction and recognizable as a counterfeit. Today, the product has been modified and is difficult to distinguish from the authentic CAT.

The Element Cat (E-CAT) is a very carefully made counterfeit CAT tourniquet, manufactured in Hong Kong for \$8.50 each. It was designed to look, feel, and act like the real thing.

The authentic item has a National Stock Number of 6515-01-521-7976 and has a unit cost of \$27.28.

"The markings appear to be a copyright or trademark infringement, and that is why law enforcement has become involved in the investigation," COL Kragh noted. "We have had a previous counterfeit CAT confirmed from the Middle East, but this was purged from the warehouses uneventfully a couple of years ago. This is one of the reasons why we should remain vigilant."

As to why anyone would purchase the fake one while the authentic item is available through Army supply channels, COL Kragh had a possible explanation.

"The ordering system is decentralized giving initiative to low-level supply persons who can order what they think is best. An unknowing person could easily think that they are ordering a Combat Application Tourniquet online for a good price, but getting one cheap from China is too good to be true," Kragh said.

Information about the proper combat application tourniquet can be seen on the U.S. Army Medical Materiel Agency website (<http://www.usamma.army.mil/assets/docs/CAT.pdf>) under the category "Hot Topics."

An information line at (301) 619-3548 is also available.



The authentic tourniquet has a manufacturing date stamped on it (bottom).



The difference in packaging between the real Combat Application Tourniquet (left) and the counterfeit model (right) is obvious.

Part One

Regional Anesthetic Blocks for the Care of Minor Upper Extremity Wounds

Dr. Bruce C. Arne'

This series originally were printed in *SWAT DIGEST*. Some of the material was edited to make it pertinent to the SOF medics for deployments. The author personally administered these blocks while working in austere environments, far away from medical support and can attest to their effectiveness. These procedures provide for the SOF medic and physician a review of techniques and procedures that are already in use especially with the transporting of casualties over long distances. For those unfamiliar with the techniques, it is simply another tool for the tool box.

Serving on an extended, remote operation such as a natural disaster such as Hurricane Katrina or the Haiti earthquake, a long patrol near the Afghanistan border, or even a deployment to a U.S. territory, often CASEVAC/MEDEVAC is not an option due to location, terrain, or an LZ not being secure for aircraft to land. Sometimes, during these operations, it is imperative to remain covert or, as with the Katrina disaster or Haiti earthquake, advanced medical care may not be an option. What are the medic's or physician's options for treating extremity wounds, that are minor in nature, but severe enough to possibly require a visit to the operating room (OR), when a MEDEVAC is not desirable, or available?

When the team leader's upper extremity abrasion gets infected and requires a wash out or the team's breacher uses too much plastic explosives and now looks like a porcupine with pieces of door sticking out of his arm, providing adequate anesthesia for the treatment of these minor wounds becomes a top priority. This article will relate different techniques for providing anesthetic blocks to the upper extremities that are already being taught to the SOF Medic (therefore, it is a review of techniques). All techniques should be attempted initially in a controlled environment (i.e., prior to the deployment and on as many team members as possible). The blocks discussed are easy to give and, the risks for the patient are minor and seldom encountered.

BIER BLOCK

This block will only anesthetize an extremity and is not a central block. It can be used on both upper and lower extremities, although the author had more success on upper extremities. This block can be used for wound care, minor amputations, and setting of minor fractures.

Begin by starting an IV (e.g., 20 gauge) as distal as possible in the hand and cap it off (no IV flow). Elevate the arm above the heart and exsanguinate it with a tightly wrapped Esmarch bandage. The Esmarch is a wide, rubber band that is wrapped around the extremity from distal to proximal. This effectively squeezes the blood out of the arm. While the Esmarch is in place, and with the arm elevated, apply and inflate a blood pressure (BP) cuff on the upper portion of the arm. Inflate the cuff to 150mmHg above the patient's systolic pressure and clamp the tube off to prevent air leakage of the cuff. Keep the cuff inflated for at least 25 minutes. (Unbearable cuff pain usually occurs after one hour after inflation. However, in the operating room the cuff may be left inflated for upwards of 1.5 hours due to the ability to administer pain meds and anxiolytics. The SOF medic may have the ability to perform a light sedation and this will help with any breakthrough pain). Remove the Esmarch bandage and confirm the absence of a distal pulse in the extremity. Uncap the IV and slowly inject 50ml of 0.5% plain lidocaine (without epinephrine) into the catheter. The arm will now be adequately anesthetized for a surgical procedure. Logic dictates that this block should be only be used when the lack of blood flow to the damaged area will not affect the retention of the appendage (i.e., finger or hand), as the cuff will block blood flow and oxygen to the area.

At the end of the procedure, slowly deflate the cuff to allow the lidocaine to be cleared out of the arm by the now functioning circulation in the extremity. If the cuff must be let down prior to 25 minutes, then the patient must be watched for lidocaine toxicity.

EDITOR'S NOTE: The symptoms of lidocaine toxicity tend to follow a predictable progression. The toxicity begins with numbness of the tongue, lightheadedness, and visual disturbances and progresses to muscle twitching, unconsciousness, and seizures, then coma, respiratory arrest, and cardiovascular depression.

This block works well and usually provides complete anesthesia of the arm distal to the BP cuff. It can be augmented with local anesthetic at the site of the surgery if there is still the sensation of pain. Remember, the maximum dose of plain lidocaine is 5mg/kg (It is actually slightly higher than that, but when in the field, overdosing on lidocaine is not recommended). Therefore, for a 70kg patient (154lbs) the max-

imum dose is 350mg (70 x 5mg). So, even with the 50ml or 250mg total dose needed for an effective block (0.5% lidocaine at 5mg/ml x 50ml= 250mg), it is still well below the toxic dose for a 154 pound. person.

ULNAR NERVE BLOCK

The ulnar nerve is the nerve that reacts when you hit your elbow or your “funny bone” causing tingling or a loss of sensation from below the elbow and possibly up to the shoulder. It can be palpated easily as it runs in a groove on the medial posterior side of the elbow. Simply inject 5-10ml of local anesthetic (with or without epinephrine) approximately 3cm proximal to the elbow joint in a fan pattern. In other words, measure from the elbow (going towards the shoulder) approximately 3cm and give the injection. Refer to Figure 1 for the location of the block and Figure 2 for the area anesthetized.

MEDIAN NERVE BLOCK

The median nerve is medial to the brachial artery. The artery/ pulse can be palpated on the medial side of the biceps approximately 2-3cm above the elbow crease. The nerve is anesthetized with 5-10ml of local anesthetic, with or without epinephrine and given in a fan pattern. Refer to Figure 1 for the location of the block and Figure 2 for the area anesthetized.

RADIAL NERVE BLOCK

The radial nerve lies lateral to the biceps tendon at the level of the elbow joint. Insert the needle 1-2cm lateral to the tendon and 2cm towards the shoulder and advance it until it contacts the lateral epicondyle. Inject 3-5ml of local anesthetic with or without epinephrine. Refer to Figure 1 for the location of the block and Figure 2 for the area anesthetized.

Blocks for the arm below the elbow will need to be augmented with local anesthesia if the area to be operated on includes the forearm as the musculocutaneous nerve may not be anesthetized by the radial nerve block. Also, keep in mind that epinephrine in the anesthetic is a great vasoconstrictor. Therefore, a block given some distance away from the site of injury will not help with hemostasis as is the case when infiltrating into the wound itself. This brings up the question, “why not just infiltrate lidocaine into every wound to be treated?” Most wounds can be anesthetized by simply infiltrating lidocaine; however, due to the chemical structure of lidocaine, its duration is limited and is based on the volume injected. Marcaine, due to its chemical structure, does not work well with infiltration into a wound because of its long onset. But, it will give superb anesthesia for blocks that may last upwards of eight hours (especially for the three blocks mentioned above). This will give the medic more than enough time to treat the patient while also allowing the patient to have a longer period with some pain relief.

WRIST BLOCKS

All three nerves mentioned above can be blocked at the level of the wrist as well. The ulnar and median nerves can be blocked by infiltrating anesthetic lateral to and between the two tendons that flex the palm towards the body. The needle should be inserted 90 degrees to the skin and approximately 2cm from the wrist crease (heading towards the elbow) and should pierce the fascia prior to depositing 3-6ml of anesthetic. Anesthetize the radial nerve by infiltrating the anesthetic subcutaneously 2cm from crease of the wrist just lateral to the radial artery. The subcutaneous infiltration should continue past the joint of the thumb and just onto the back of the wrist.

The use of the wrist block and the other blocks mentioned above will allow the medic or physician, while treating patients in austere environments, to use epinephrine with lidocaine or Marcaine while working on the hand or fingers. In addition, the blocks will also allow for extended anesthetic time so the team does not have to stop sewing to re-anesthetize. This will allow the team members to get back on the mission faster and possibly eliminate the need for an unwanted MEDEVAC.

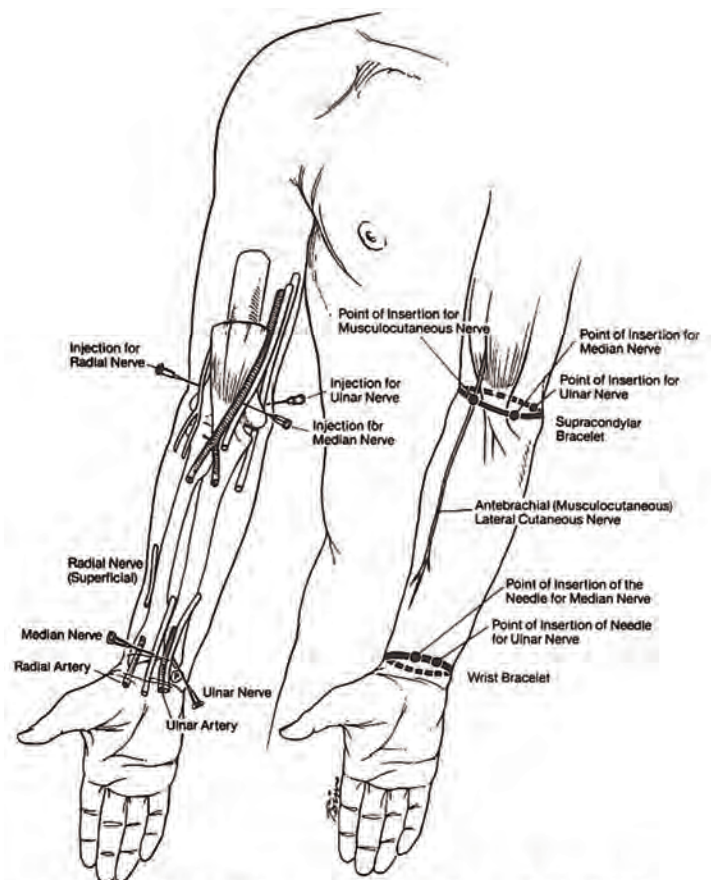


Fig. 1. Deep anatomy for elbow and wrist blocks of radial, ulnar and median nerves

(From Raj, P.P. Clinical Practice of Regional Anesthesia. New York: Churchill Livingstone, 1991.)

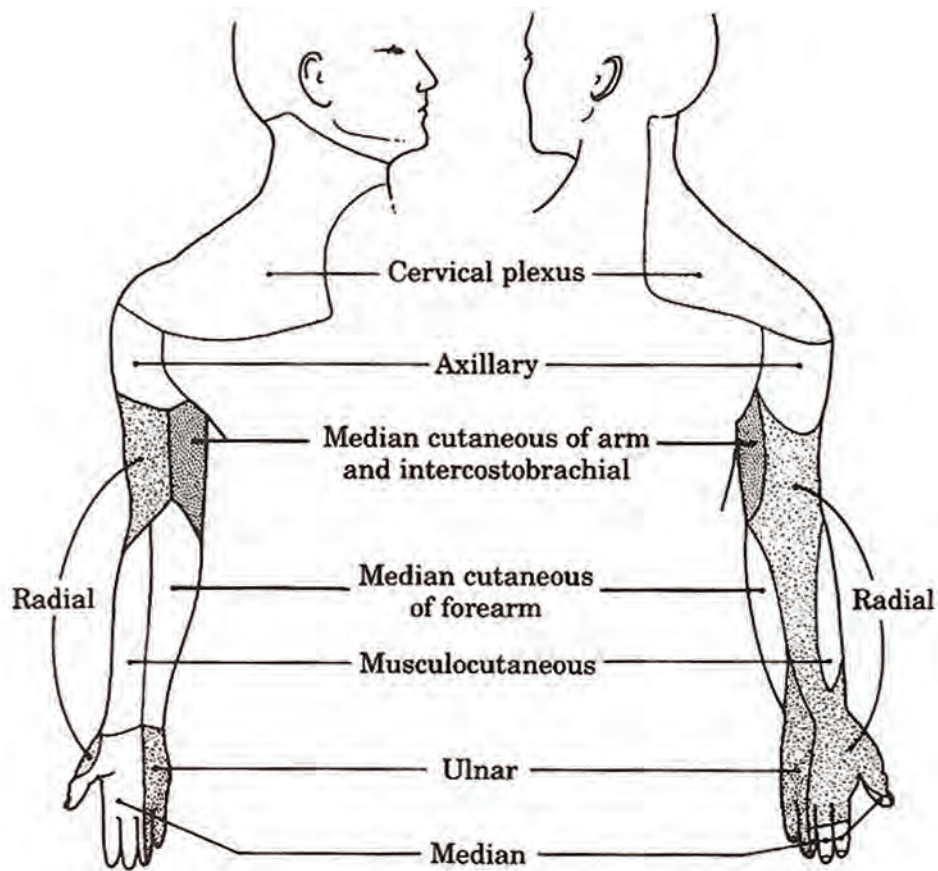


Fig. 2. Cutaneous peripheral nerve supply of the upper extremity
 (From Clinical Anesthesia Procedures of the
 Massachusetts General Hospital. Philadelphia: Lippencott- Raven. 1998.)

Part Two

Regional Anesthetic Blocks for the Care of Minor Lower Extremity Wounds

Dr. Bruce C. Arne'

Care of and trauma to the lower extremities is an ongoing battle throughout life. During the natural aging process, years of walking, running, hiking, ... virtually all activities of daily living that require a standing position, add more and more stress and strain to the lower back, hips, knees, ankles, and feet. Include the fact that the majority of tactical operators played sports while growing up – whether it was baseball, basketball, soccer, or football. Now add to that the 10-15 years lifespan of active Special Operations deployments, where the daily stresses and strains on the lower extremities are magnified. Plus, having to carry anywhere from 50-100 lbs. during missions, it is easy to understand why our knees, ankles, and feet hurt constantly. In the past three years, I personally have dealt with a torn left anterior cruciate ligament (ACL), plantar fasciitis, and am looking at having bone spurs removed from both of my ankles from years of playing soccer in high school, college and as part of the Olympic Development Program (ODP). Added to that trauma is the continuation of carrying of heavy loads on tactical missions, it is not hard to understand why I can tell when the weather is going to change for the worse hours before it happens.

During the first days after Katrina, while the water was still high, many USAR personnel injured their feet, knees, and ankles just walking around. Boots are no match for sharp rebar and cement. Also, (during Katrina) as the sewers flooded, the upward pressure of the water lifted the manhole covers off the streets and floated them away. Indigenous personnel and USAR were walking around and stepping into the open vertical pipes and snapping ankles, knees, and getting dunked in sewage. Haiti was not much different.

For the SOF medic, you live with these issues on a daily basis. I cannot emphasize enough the importance of actively treating as many patients as you can, before you deploy, so that when (and it will happen) someone injures their leg, the mission can continue. In Part II, I discuss how to anesthetize the lower extremity via blocks. I will ask you to refer to Part I and the discussion regarding the appropriate anesthetic to use. Remember, lidocaine with epinephrine has a faster onset and a shorter lifespan than Marcaine with epinephrine, which is much slower in onset but provides profound anesthesia for a longer period of time.

BIER BLOCK

This block was discussed at length in the previous article regarding upper extremity blocks. It is, in general, an excellent way to anesthetize an extremity. However, in my personal experience, I have had more success with the block on the arms. When this block takes, anesthesia is profound with the exception of tourniquet/cuff pain that may occur as early as after 45 minutes but usually doesn't become unbearable until the one hour mark is reached. To alleviate the pain from the cuff, the Bier block may also be used in conjunction with other blocks. Just keep in mind the maximum dosages

for lidocaine and Marcaine when combining different techniques.

Begin by starting an IV (20 gauge will do) as distal as possible in the foot and cap it off (no IV flow). Elevate the foot above the heart and exsanguinate it with a tightly wrapped Esmarch bandage. The Esmarch is a wide, rubber band that is wrapped around the extremity from distal to proximal (A tightly placed ACE bandage may be just as useful). This effectively squeezes the blood up the length of the leg. While the Esmarch is in place, and the leg elevated, apply and inflate a BP cuff on the upper portion of the thigh. Inflate the cuff to 150mmHg above the patient's systolic pressure and clamp the tube off to prevent air leakage of the cuff. The cuff should be inflated for at least 25 minutes. (As previously stated, unbearable cuff pain usually occurs after one hour after inflation. However, in the operating room (OR), the cuff will be left inflated for upwards of 1.5 hours due to the ability to administer pain meds and anxiolytics. The SOF medic can also perform a light sedation if the correct medicines and monitors are available.) Remove the Esmarch bandage and confirm the absence of a pedal pulse in the extremity. Uncap the IV and slowly inject 100ml of .25% plain lidocaine (without epinephrine) into the catheter. In approximately five minutes, the leg will be adequately anesthetized for a surgical procedure. Logic dictates that this block should only be used when the lack of circulation to the damaged area will not affect the retention of the appendage (i.e. toes or foot), as the cuff will block blood flow and oxygen to the area.

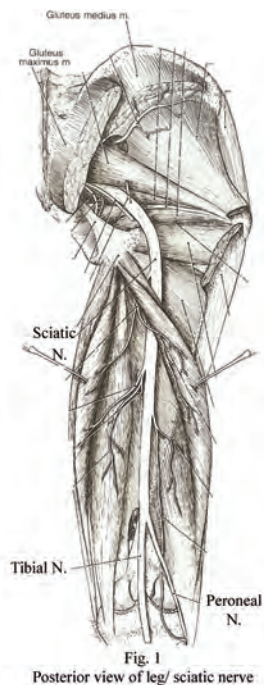
At the end of the procedure, slowly deflate the cuff to allow the lidocaine to be cleared out of the leg by the now functioning circulation in the extremity. If the cuff must be let down prior to 25 minutes, then the patient must be watched for lidocaine toxicity.

This block works well and usually provides complete anesthesia of the leg distal to the BP cuff. It can be augmented with local anesthetic at the site of the surgery if there is still the sensation of pain. Remember, the maximum dose of plain lidocaine is 5mg/kg. Therefore, for a 70 kg patient (154 lbs) the maximum dose is 350mg (70 x 5mg). So, even with the 100ml or 250mg total dose needed for an effective block (0.25% lidocaine at 2.5mg/ml x 100ml= 250mg), you are still well below the toxic dose for a 154lb person. Complications come from not having a cuff of adequate size to fit around the calf muscle or thigh. Thus, the circulation is never adequately stopped and the local anesthetic will slowly seep out into the body.

POSTERIOR LEG / POPLITEAL FOSSA / SCIATIC NERVE BLOCK FOR KNEE INJURIES

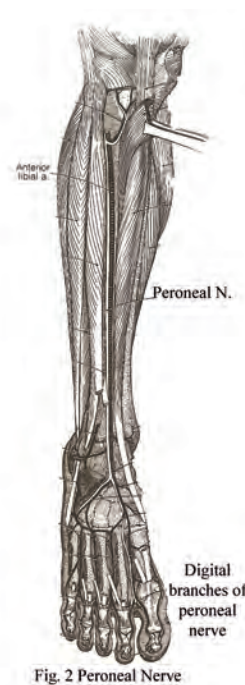
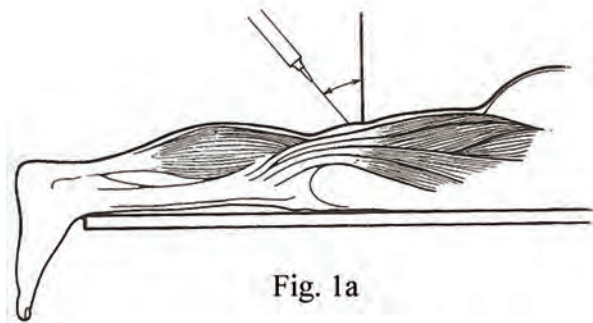
While many operations on the lower extremity can be handled by direct infiltration into the wound, sometimes there is the need to perform a regional block. The sciatic nerve (posterior leg) can be blocked efficiently at two locations. One lo-

cation is at the glutes (buttocks) before the nerve inserts under the musculature of the posterior upper leg and the other is above the posterior knee where it exits before splitting to become the tibial nerve and the peroneal nerve. The tibial nerve continues past the knee and through the calf musculature to supply the bottom of the foot. Therefore, blocking the nerve at the knee will also block the medial and lateral plantar nerves of the foot as well (see Figures. 1, 1a, and 3). The sciatic nerve can be easily blocked at the posterior knee. With the patient in a facedown position, flex the knee approximately 30 degrees. This will outline the borders of the popliteal fossa. The inferior boundary is the crease of the knee, the medial boundary is the semimembranous and semitendinous muscles, and the lateral boundary is the biceps femoris muscle. A needle is inserted 6cm superior (along a vertical line) to the knee crease and 1 cm lateral to that line. The depth of the nerve is approximately halfway between the skin and the femur. The patient will tell you when you are close or have actually touched the nerve as they will have “an electrical shock” sensation along the posterior aspect of the calf and foot. Withdraw the needle slightly and inject 30-40cc’s of Marcaine or lidocaine.



To block the anterior knee, the femoral, lateral femoral cutaneous and obturator nerves must be anesthetized as well. Blocks for all three nerves (a 3-in-1 block or psoas block) require longer needles and a good working knowledge of the anatomy of the groin and lumbar plexus. These blocks take practice to master and often are incomplete as one of the nerves is missed in the block or epidural anesthesia is inadvertently initiated. The result of missing the block is having to infiltrate anesthetic into the area being operated on. When faced with this situation, I would opt to infiltrate lidocaine with epinephrine into and around the wound and anesthetize the area as opposed to attempting a block that I do not use on a regular basis. If given deep enough, this will also anesthetize the branches distal to the site of the injection, giving

what is known as a field block. Again, any practice that you can get is beneficial. I suggest asking an Anesthesiologist if you can shadow him or her for a couple of days. Request assignments for orthopedic surgeries as the 3-in-1 and the psoas blocks are regularly used in the OR.



ANTERIOR TIBIA AND ANKLE BLOCKS

As can be seen in Figure 2, the peroneal nerve runs adjacent to the anterior tibial artery and lateral to the tibia at the level of the knee cap. If it is desirable to block the nerve high (up near the knee) then palpate the lateral head of the Tibia (called Gerdy’s tubercle) and inject the local laterally, and inferiorly to this point. Gerdy’s tubercle can be found by flexing the knee; there will be two bony landmarks found lateral to the patellar tendon. The posterior bony landmark is the head of the fibula, the anterior bony landmark or prominence is Gerdy’s tubercle. Injecting here will effectively anesthetize the anterior shin and top of the foot. In fact, I would recommend anesthetizing here for any injuries to the anterior shin instead of trying to hit the nerve farther down the leg. As with all injections, aspirate first to ensure that you are not in the artery or vein when injecting. If you get a “flash” of blood in the syringe, then withdraw the needle slightly, redirect, aspirate again and inject.

Blocking the ankle is simply a combination of the all the above mentioned blocks. The most effective technique is to perform a ring block around the ankle (See Figure 4).

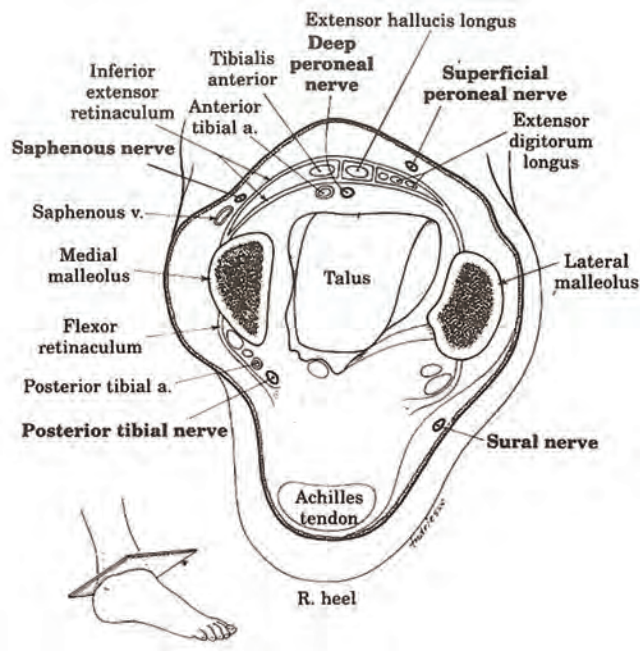


Figure 4: Right foot at the ankle

The posterior tibial nerve is the major nerve of the sole of the foot. It is easily anesthetized by injecting 5-10cc of local anesthetic behind the medial malleolus and anterior to the Achilles tendon. This nerve is slightly deeper than the sural nerve and it may be necessary to palpate the posterior tibial artery and inject behind that vessel.

The injections are made at five separate nerve locations. The anterior nerves (saphenous, deep peroneal and superficial peroneal) can all be blocked by infiltrating subcutaneously. To ensure anesthesia of the deep peroneal nerve, the needle may have to be passed deep to the ligament or retinaculum (see figure 5). Asking the patient to flex their big toe will help identify the tendon. This will allow the needle to be passed deep to this landmark. The sural nerve is easily anesthetized by injecting 5cc of anesthetic lateral to the Achilles tendon and behind the lateral malleolus. The injection should be given subcutaneously and in a fan shaped pattern if needed.

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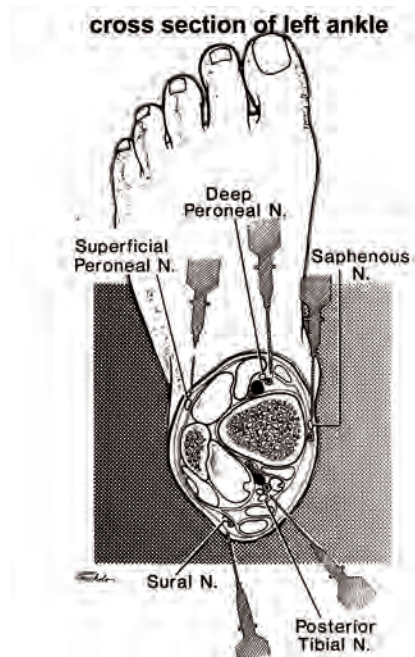


Figure 5: Left foot at the ankle

Prior to doing a residency in oral and maxillofacial surgery, Dr. Arne' was a resident in anesthesiology at the University of NC, Chapel Hill. Dr. Arne' maintains a private practice in oral and maxillofacial surgery in Wilmington, NC, as well as holding a clinical teaching position as an Associate Clinical Professor at the UNC-CH in the Department of Oral and Maxillofacial Surgery. Dr. Arne' is also a certified Disaster Medical Specialist who works with the NC State Medical Assistance Team and is the Team Leader of the NC Rapid Assessment Team (an all hazards team that was developed to assist law enforcement with high risk warrant service and respond to disasters – both natural and manmade). The team members work very closely with the law enforcement community in assisting during combined operations. Dr. Arne' can be reached via email at barne@coastalcarolinaos.com.



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Meet Your JSOM Staff

EXECUTIVE EDITOR

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COL Deal has also completed Combat Casualty Care Leadership Course (C4A) –1991, Pre-Command Course, Fort Leavenworth – 1994, Senior Officer’s Legal Orientation, Charlottesville -- 1994, Combatant Commander’s Surgeons Course – 1996, AMEDD Pre-Command Course, Fort Sam Houston – 1998, Basic Life Support – current, Advanced Cardiac Life Support, Advanced Trauma Life Support, and Pilot, single engine, land, instrument.

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As a Special Forces Aidman of the United States Army, I pledge my honor and my conscience to the service of my country and the art of medicine. I recognize the responsibility which may be placed upon me for the health, and even lives, of others. I confess the limitation of my skill and knowledge in the caring for the sick and injured. I promise to follow the in- maxim "Primum non nocere" ("First, thou shalt do no harm"), and to seek the assistance of more competent medical authority whenever it is available. These confidences which I will treat as secret. I recognize my responsibility to impart to others who seek the service of medicine such knowledge of its art and practice as I possess, and I resolve to continue to improve my capability to this purpose. As an American Soldier, I have determined ultimately to place above all considerations of self the mission of my team and the cause of my nation.



Pararescue Creed

I was that which others did not want to did what others failed to do. I asked And reluctantly accepted the I fail. I have seen the face of terror; joyed the sweet taste of a moment's hoped...but most of all, I have lived ten. Always I will be able to say, that my duty as a Pararescueman to save a my assigned duties quickly and efficiently, placing these duties before personal desires and comforts.



be. I went where others feared to go, and nothing from those who gave nothing, thought of eternal lonliness ... should felt the stinging cold of fear, and en- love. I have cried, pained and times others would say best forgot- I was proud of what I was: a PJ It is life and to aid the injured. I will perform

These things I do,
"That Others May Live."

A Navy Poem

I'm the one called "Doc"... I shall not walk in your footsteps, but I will walk by your side. I shall not walk in your image, I've earned my own title of pride. We've answered the call together, on sea and foreign land. When the cry for help was given, I've been there right at hand. Whether I am on the ocean or in the jungle wearing greens, Giving aid to my fellow man, be it Sailors or Marines. So the next time you see a Corpsman and you think of calling him "squid," think of the job he's doing as those before him did. And if you ever have to go out there and your life is on the block, Look at the one right next to you...



I'm the one called "Doc".

~ Harry D. Penny, Jr. USN Copyright 1975

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